TITLE

Summary of Studies Conducted or Supported by Monsanto To Support Re-Registration of M1768 (EPA Reg. No. 524-617)

DATA REQUIREMENTS

None

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Executive Summary

EPA approved the registration for XtendiMax® With VaporGrip® Technology (XtendiMax; EPA Reg. No. 524-617) on November 9, 2016, and then again on November 1, 2018, for uses on dicamba-tolerant soybean and cotton. These registrations were based on a range of scientific submissions provided to the agency over the preceding several years, including dozens of scientific studies and field trials conducted by Monsanto Company[1] and by academic scientists assessing the potential for spray drift and volatility. As EPA explained in the 2018 registration decision, evidence from these studies supported the effectiveness and protective nature of the 110-foot downwind buffer requirement for XtendiMax and other mandatory label restrictions, such as a 57-foot omnidirectional buffer in certain counties where endangered plant species are found.

Unless renewed by EPA, the November 2018 registration automatically expires on December 20, 2020. EPA requested additional confirmatory studies as part of the 2018 registration decision, which were submitted on January 15, 2020, including (a) large-acre field studies examining drift and volatility as well as impacts on plant height and yield; (b) a field study evaluating the effects of dicamba-containing agricultural irrigation water on non-target plants; (c) a humidome study investigating potential effects on volatility from temperature and other variables; (d) a tiered ecological effects study on select tree species; and (e) a study evaluating the effect of pH on secondary movement of dicamba. Since these were non-guideline studies, prior to developing a protocol and initiating any study, Monsanto met with EPA staff to present and engage in a data quality objective discussion regarding environmental conditions, sampling, and species evaluation. Monsanto submitted study protocols to EPA for review and incorporated the Agency's feedback into study design before beginning the studies.

The results of the 2019 studies are consistent with prior field studies conducted by Monsanto and academic scientists. This submission summarizes: (i) the results from 2019 studies conducted by Monsanto as required by the 2018 conditions of registration, (ii) prior studies conducted by Monsanto, (iii) studies conducted by academics in 2017, 2018 and 2019, (iv) USDA soybean yield data for 2018, and (v) Monsanto off-target movement inquiry data for 2019.

Field Volatility Studies: To-date, 30 field studies of dicamba off-target movement have been conducted by Monsanto and academic scientists over a broad range of geographies, temperatures, humidities, soil types, growth

[1] The Bayer Group has acquired Monsanto Company, the registrant for XtendiMax. Bayer brand is now the corporate brand for the combined company, however the legal entity Monsanto Company continues to operate with the same name and remains responsible for maintaining compliance with all relevant statutory, regulatory and permit requirements.

stages, field sizes and environmental conditions that are highly representative of farming conditions in the United States where cotton and soybean are grown. The evidence from these field studies is consistent with EPA's November 2016 and 2018 XtendiMax registration decisions, which concluded that spray and vapor drift will not occur past the label's required buffer distances in levels that would cause significant reductions in plant height.

As required by the 2018 XtendiMax conditions of registration, Monsanto conducted three large-acre studies in 2019 in Illinois, Missouri, and Mississippi that measured dicamba levels outside the treated field and included an assessment of plant effects on dicamba sensitive soybeans from primary and secondary routes of exposure. These field studies (a) confirm that total volatile mass loss from the field is consistent with the estimates from studies previously reviewed by EPA, (b) confirm that off-target air concentration and deposition from dicamba volatility as modeled using EPA guidelines are protective of non-target species, (c) are consistent with EPA's conclusion that the label's existing downwind buffer is protective of spray drift deposition, (d) are consistent with EPA's conclusion that the existing label buffer is protective of any significant reductions in plant height as a results of spray drift, and (e) confirm that non-downwind locations are not exposed to spray drift or volatility following on-label applications.

Academic scientists have conducted a total of 13 studies evaluating the off-target movement potential of XtendiMax under typical agronomic conditions. In 2017, academics from universities in Indiana (Dr. Bryan Young), Arkansas (Dr. Jason Norsworthy) and Missouri (Dr. Kevin Bradley), tested the off-target movement potential of XtendiMax. In 2018, academics from universities in Arkansas, Nebraska, Indiana, Michigan, and Wisconsin tested XtendiMax's off-target movement potential of an XtendiMax and Roundup tank mix. Except for the Nebraska study, the volatile mass loss from the remaining four studies is consistent with the mass loss in 16 field studies provided by Monsanto to date to EPA, which have shown that resulting off-target concentration are well below the refined NOAEC of 138 ng/m^3 (MRID 50578901). Even with slightly higher volatile mass loss in Nebraksa (0.62% of applied), the average distance to 5% reduction in plant height was 12 m, which is protective with the current label buffer of 33.5 m.

In 2019, academics from universities in Alabama, Georgia, Missouri, Nebraska, and Wisconsin assessed the off-target movement potential of an XtendiMax and Roundup tank mix. In addition to geographical diversity, these studies captured a range of spray conditions, including varying application areas (5 to 40 acres), air temperatures (86 ^{o}F to 99 ^{o}F), crop heights (up to 30 inch soybean), and relative humidities (32% to 100%). The total dicamba volatile mass loss from these five studies ranged from 0.03% to 0.16% of applied dicamba. In other words, this mass loss data is consistent with all studies conducted to date, and the extent of volatility occurring in the field is minor. In these studies, no correlation was observed between application area, air temperature, crop height, relative humidity and volatile mass loss, indicating that no single variable drives the small amount of dicamba mass loss observed.

Effects Studies: Soybean yield studies conducted in conjunction with the above field volatility studies in Illinois, Missouri and Mississippi in 2019 using multiple application rates confirmed that the plant height endpoint is more sensitive than effects on yield, regardless of plant stage at application. These results therefore confirmed EPA's conclusions in prior registration decisions that regulatory endpoints based on plant height are protective of effects on yield.

A tree study evaluated the relative sensitivity of dicamba to five species of tree seedlings which received a application rate equivalent to the rate shown to cause a 25% effect in soybean. Tier I results confirmed that four species—Apple, Cherry, Swamp Cypress, and Sycamore—were no more sensitive to dicamba than soybean (effects <25%) after exposure to dicamba at a rate of 0.000513 lb a.e./A under greenhouse conditions. For the Red Oak species, additional tier II testing (dose response) is required to further assess the relative sensitivity compared to soybean, which Monsanto expects to complete by the summer of 2020.

Irrigation Study: A field irrigation runoff study was conducted to determine the levels of dicamba in intentionally generated runoff water during furrow irrigation events following an application of a dicamba formulation (Clarity; EPA Reg. No.: 7969-137) to dicamba tolerant (DT) soybean under field conditions. Due to very wet conditions in the spring and early summer in Midwest and several rain events on the field prior to the irrigation event, soil moisture levels were high, thus maximizing runoff from the irrigation event. In addition, the timing of the irrigation relative to the crop growth stage was considered highly conservative for runoff potential, as there is minimal canopy coverage and typically furrow irrigation isn't necessary until the R1 to R3 growth stages. The total dicamba mass loss was 0.25% (irrigation at 2 days after application) and 0.12% (irrigation at 7 days after application) of applied. This study confirmed the low runoff potential of dicamba in irrigation water under conservative field conditions that promote runoff.

Humidome Study: A dicamba humidome (closed dome system) study was conducted in a controlled environment to assess the relative effects of temperature, relative humidity, and pH on the dicamba volatility potential of XtendiMax over the first 24 hours after application. The humidome study showed that: (a) temperature had the largest relative effect on dicamba volatility potential; (b) decreasing pH was not found to affect volatility potential at 30ºC (86ºF) and 35ºC (95ºF); (c) relative humidity was found to have a negligible effect on volatility within the range of this study. Humidome studies such as this one are useful for relative comparisons and provide valuable information without the complications of environmental variability in the field, however they are lower-tiered studies and thus do not provide realistic estimates of field volatility. For instance, even though temperature was found to have the greatest effect on dicamba's volatility potential in this humidome study, it is not predictive of volatility potential in the field: Monsanto has conducted higher-tiered field studies under extremely high temperatures and found volatility remains low. Specifically, field studies conducted in 2017 (Australia) and 2018 (Arizona) both had a maximum air temperature of 41°C (106°F) yet predicted air concentrations outside of the treated area were well below the NOAEC. Since temperature had the largest relative effect on dicamba volatility in the humidome, and previous field studies demonstrated the lack of adverse effects outside the spray application area at high temperatures, adverse effects would not be expected as a result of the range of pH and relative humidity condtions evaluated in the humidome study.

Tank Mix and Source Water pH Effects: Two studies evaluated the role of pH on dicamba volatility. The first evaluation was to summarize the tank mix pH and corresponding air concentration data from humidome studies in which XtendiMax was mixed with an additional tank mix partner. The second evaluation was to summarize water pH in 34 states where cotton and soybean are grown. From the large database of humidome test results using XtendiMax with various tank mix partners, there is no correlation between pH and dicamba air concentrations measured in the humidome *en masse* or by tank mixture class. Based on an extensive source water dataset, comprising of 34 states and thousands of samples, average groundwater pH ranged from 6.1 to 7.8 and average non-groundwater (i.e. including surface water) pH ranged from 6.5 to 8.2.

2018 USDA Yield Data: Publicly-available soybean yield data for 2018 compiled by the U.S. Department of Agriculture confirms data from 2016 and 2017 showing that there are no widespread yield impacts due to the off-target movement of dicamba. Even in Illinois, Iowa and Indiana—which received many of the grower inquiries about potential impacts to crops from off-target movement of dicamba—yield increased in 2018 relative to 2016 and 2017 or remained steady. Illinois, for example, accounted for 26% of all the nationwide inquiries related to alleged dicamba off-target movement in the 2018 growing season, but also experienced the highest soybean yields per acre in the state's history that year.

Off-Target Inquiries: This submission also addresses inquiries of possible off-target movement reported to Monsanto during the 2019 growing season. Monsanto has conducted a detailed and robust evaluation of each inquiry it received. The number of inquiries received by Monsanto decreased in 2019 compared to 2018 and 2017. During this same time, Xtend soybean and cotton acreage continued to increase. Additionally, Monsanto received fewer off-target movement inquiries in 2019 relative to 2018 for most individual states where XtendiMax is registered, including Illinois, Indiana, Minnesota, Tennessee and Missouri, which together accounted for the majority of inquiries in 2018, experienced a lower number of inquiries in 2019 relative to 2018. In 2019, particularly in Illinois, for many of the inquiries that we investigated involving non-applicator reported acres, adjacent corn fields surrounded non-dicamba tolerant soybean fields. Given late planting this season (mainly due to extreme weather conditions), those corn fields may have received an application of dicamba or another auxin at the same time as over-the-top dicamba soybean applications.

A Total of 30 Monsanto and Academic Field Studies Conducted With XtendiMax Are Consistent With EPA's Conclusion that Label Requirements Are Protective of Effects from Spray Drift and Volatility, and that Volatility Is a Minor Component of Off-Site Movement

To-date, 30 field studies of dicamba off-target movement have been conducted by Monsanto and academic scientists[2] over a broad range of geographies, temperatures, humidities, soil types, growth stages, field sizes and environmental conditions that are representive of typical cotton and soybean growing regions in the United States. Dicamba air concentrations and meteorological data were recorded at each test site, and were used to calculate flux over the sampling duration utilizing multiple flux methods. Only the highest flux values from these flux methods were used to model off-target air concentration and deposition due to volatility. The weight of evidence from these 30 field studies and modeling data are consistent with EPA's conclusions in review of the November 2016 and 2018 registration decisions that spray and vapor drift will not occur past the label's required buffer distances in amounts that would have an adverse effect on plant height.

In 2015 and 2016, Monsanto conducted six volatility field studies in Georgia and Texas—four using XtendiMax and two using Clarity. In EPA's assessment of four of these studies in the November 2016 registration decision, EPA concluded that the weather conditions present during these studies "made for near-idealized conditions for volatilization occurring after applications," thus approaching the worst-case scenario for maximizing dicamba's volatility.

Monsanto conducted six additional field volatility studies in 2018 that provided volatility data for the common tank mix of XtendiMax and Roundup PowerMax (glyphosate), while a 2017 field study in Australia evaluated the same tank mix under extreme heat (106 °F). These studies assessed the following: (a) volatility potential of XtendiMax applications in key geographical agronomic regions that represent a range of environmental conditions, including air temperatures over 100 °F, and varying crop height conditions, including closed canopy

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[2] Studies conducted by Dr. Kruger in 2017 and Dr. Norsworthy in 2018 are not included in this discussion because EPA's 2018 updated effects determination identified confounding issues in Dr. Kruger's study and deviations from protocol in Dr. Norsworthy's study. *See* 2018 Summary of New Information and Analysis of Dicamba Use on Dicamba-Tolerant (DT) Cotton and Soybean including Updated Effects Determination for Federally Listed Threatened and Endangered Species at 25-26, 86-87, 131-33.

conditions, (b) volatility potential of XtendiMax applications on large acres (up to 100 acres), (c) volatility potential of XtendiMax up to 7 days after application, (d) validation off-target dicamba air concentration estimates via incorporation of an additional flux method that uses off-target air concentration (Indirect Flux Method) and (e) dedicated flux validation analysis based on study location-specific meterological data. The methodology and results from the 2015, 2016, and 2017 studies have been accepted for publication in the Journal of Agricultural and Food Chemistry (https://doi.org/10.1021/acs.jafc.9b06451 and https://doi.org/10.1021/acs.jafc.9b06452).
In 2019, Monsanto conducted three additional field studies to assess the potential impacts of XtendiMax and Roundup PowerMax applications on plant height from primary and secondary dicamba off-target movement, with transects in all cardinal and intercardinal directions. These studies were conducted to represent long duration of measurements, varied geographic areas, areas of high dicamba use, and varied environmental conditions (e.g., temperature and humidity).

Independent academic scientists have conducted a total of 13 studies evaluating the off-target movement potential of XtendiMax under typical agronomic conditions. In 2017, academics from universities in Indiana (Dr. Bryan Young), Arkansas (Dr. Jason Norsworthy) and Missouri (Dr. Kevin Bradley), tested the off-target movement potential of XtendiMax and evaluated visual symptomology. In addition, Dr. Larry Steckel (Tennessee) tested the off-target movement potential of an XtendiMax and Roundup tank mix and evaluated visual symptomology. In 2018, academics from universities in Nebraska (Dr. Greg Kruger), Indiana (Dr. Bryan Young), Michigan (Dr. Christy Sprague), and Wisconsin (Dr. Rodrigo Werle) tested the off-target movement potential of an XtendiMax and Roundup tank mix (Soltani et al., 2020; http://doi.org/10.1017/wet.2020.17). Sprayed areas ranged from 6.9 acres (WI) to 52.9 acres (MI). The 2018 academic studies evaluated spray drift, volatile flux, and visual symptomology on covered and non-covered transects.

In addition, in 2019, academics from universities in Alabama (Dr. Steve Li), Georgia (Dr. Stanley Culpepper), Missouri (Dr. Reid Smeda), Nebraska (Dr. Greg Kruger), and Wisconsin (Dr. Rodrigo Werle) conducted additional field studies of the off-target movement potential of an XtendiMax and Roundup tank mix. In these studies, the academics were responsible for protocol development and field data collection, while Monsanto provided financial, analytical and flux modeling support.

Below are some key conclusions from the 30 studies conducted by Monsanto and academic scientists between 2015 and 2019:

Dicamba Volatility Has Been Tested in the Field in Multiple Geographic Regions

To date, Monsanto has submitted to the U.S. EPA sixteen dicamba field volatility studies across key soybean and cotton-growing U.S. states and in Australia (Figure 1,

Table 1). In addition, between 2017 and 2019, academics from nine states have tested XtendiMax's field volatility and off-target movement potential. These studies encompassed a wide range of air and soil temperatures, humidities, and crop growth stages/height, and field sizes, including field sizes up to 100 acres. Just the 2018 and 2019 dataset submitted by Monsanto includes over a 100 sampling periods and over a 1000 hours of dicamba air and meteorological sampling.

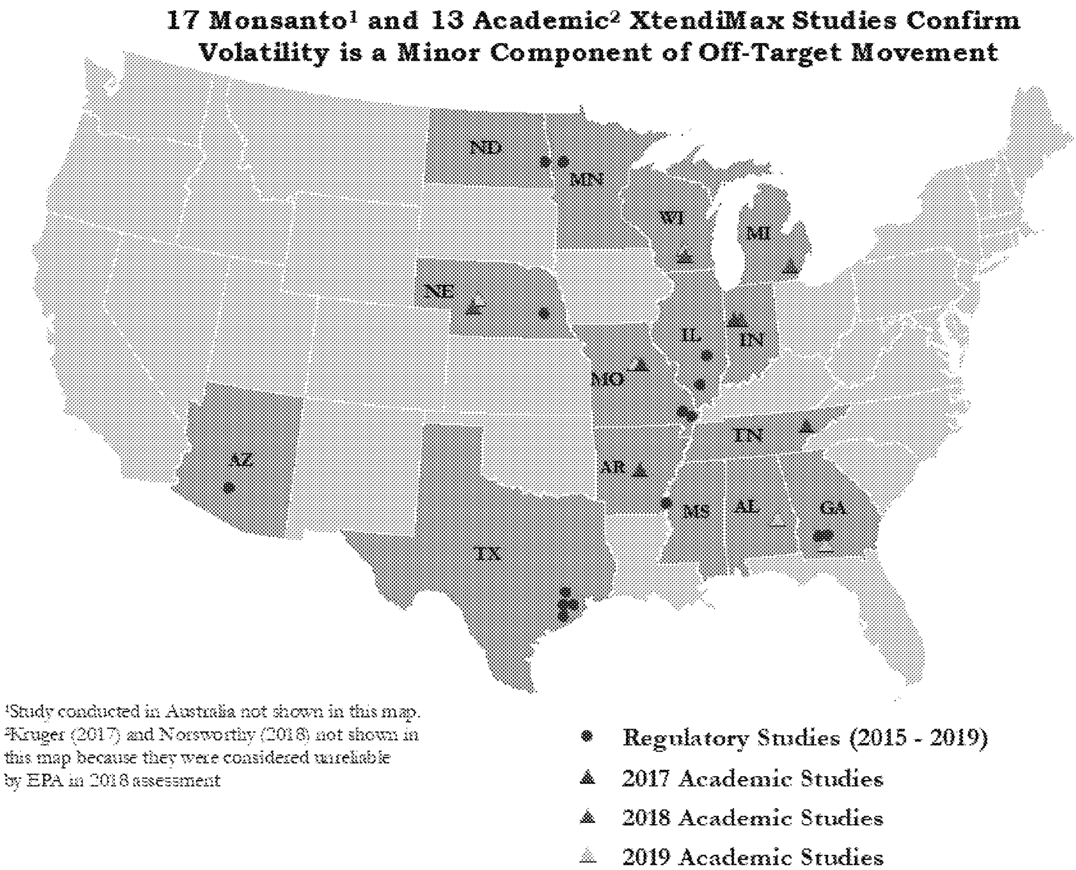

Figure 1. Thirty Monsanto and academic field studies confirm that volatility is a minor component of off-target movement

Table 1 Summary of field volatility studies conducted using XtendiMax with VaporGrip Technoloogy between 2015 and 2019

Year	MRID	State/ Country	Treatment	Spray Date	Spray Area (acre)	Crop	Crop Height (inch)	Peak. Flux (μg/m²-s)[1]	Total Mass Loss (% Applied)	Max. Soil Temp (°F)[2]	Max. Air Temp (°F)[3]	Relative Humidity (%)[6]	Off-Site Air Conc. (ng/m³)[4]	Off-Site Dry Deposition (μg/m²)[5]
2015	49888501	GA	XtendiMax with VaporGrip Technology	5/5/2015	3.4	Pre-Emergent	0	0.0010	0.05%	117	89	40.46	5.3	1.43
	49888503	TX		6/8/2015	9.6	Cotton	11	0.0003	0.04%	155	96	41.18	2.4	0.997
	49888401	GA	M1691 Herbicide	5/5/2015	3.4	Pre-	0	0.0040	0.08%	117	89	35.79	13.4	3.47
	49888403	TX		6/8/2015	9.6	Cotton	11	0.0007	0.05%	155	95	36.36	7.7	2.12
2016	50578902	TX	XtendiMax with VaporGrip + Roundup PowerMax + Intact	10/4/2016	4.6	Pre-Emergent	0	0.0039	0.20%	125	100	65.41	15.6	4.12
	50578903			10/4/2016	9.1	Soybean	4	0.0030	0.14%	125	99	65.63	12.6	3.25
2017	50606801 50606802	Australia	XtendiMax with VaporGrip + Roundup PowerMax + Intact	12/15/2017	37	Soybean	6	0.0011	0.08%	133	106	23.64	13.3	1.5
2017	Dr. Jason Norsworth	AR	XtendiMax with VaporGrip	7/20/2017	3.5	Soybean	V3/V4	NA	NA	NA	NA	NA	NA	NA
	Dr. Bryan Young	IN		8/27/2017	3.0	Soybean	V2/V3	NA	NA	NA	NA	NA	NA	NA
	Dr. Kevin Bradley	MO		7/20/2017	2.6	Soybean	R1/R2	NA	NA	NA	NA	NA	NA	NA

Year	MRID	State/ Country	Treatment	Spray Date	Spray Area (acre)	Crop	Crop Height (inch)	Peak. Flux (µg/m^2-s)[1]	Total Mass Loss (% Applied)	Max. Soil Temp (°F)[2]	Max. Air Temp (°F)[3]	Relative Humidity (%)[6]	Off-Site Air Conc. (ng/m^3)[4]	Off-Site Dry Deposition (µg/m^2)[5]
	Dr. Larry Steckel	TN	XtendiMax with VaporGrip + Roundup	7/27/2017	2.0	Soybean	V5/V6	NA	NA	NA	NA	NA	NA	NA
2018	50642801	AZ	XtendiMax with VaporGrip + Roundup Powermax + Intact	5/8/2018	27	Soybean	6	0.00054	0.09%	129	106	19.30	3.6	1.0
	50717001	MO		6/5/2018	9.1	Soybean	11	0.00089	0.20%	135	94	57.66	5.9	1.7
	50717003 50717004	MN		6/20/2018	9.1	Soybean	10	0.0010	0.09%	116	89	58.1	4.7	1.3
	50717005	NE		6/8/2018	100	Soybean	8	0.0028	0.15%	127	91	57.78	22.1	6.0
	50835001 50835002	IL		7/7/2018	9.7	Soybean	20	0.00179	0.19%	111	95	68.4	14.5	4.2
	50835003 50835004	ND		7/24/2018	9.7	Soybean	20	0.0026	0.17%	113	81	68.1	16.9	4.6
2018	Dr. Bryan Young	IN	XtendiMax with VaporGrip + Roundup Powermax + Intact	8/9/2018	20.0	Soybean	R1	0.61803	0.06%	NA	NA	NA	NA	NA
	Dr. Christy	MI		6/12/2018	52.9	Soybean	V3	0.28118	0.025%	NA	NA	NA	NA	NA
	Dr. Greg Kruger	NE		7/10/2018	29.9	Soybean	V3	7.70478	0.62%	NA	NA	NA	NA	NA
	Dr. Rodrigo	WI		7/11/2018	6.9	Soybean	V3	1.36272	0.14%	NA	NA	NA	NA	NA
2019	51017501	MS	XtendiMax with VaporGrip + Roundup Powermax + Intact	6/22/2019	25	Soybean	6.7	0.0039	0.28%	116	95	45-100%	24.3	4.6
	51017502	IL		8/8/2019	19	Soybean	7.9	0.0016	0.20%	106	87	39-100%	9.0	2.1
	51017503	MO		9/11/2019	19	Bare ground	0	0.0071	0.30%	127	98	27-100%	25.2	4.8

Year	MRID	State/ Country	Treatment	Spray Date	Spray Area (acre)	Crop	Crop Height (inch)	Peak. Flux ($\mu g/m^2$-s)[1]	Total Mass Loss (% Applied)	Max. Soil Temp (°F)[2]	Max. Air Temp (°F)[3]	Relative Humidity (%)[6]	Off-Site Air Conc. (ng/m^3)[4]	Off-Site Dry Deposition ($\mu g/m^2$)[5]
	Monsanto	IL	Xtendimax + PowerMax + Intact + MON 51817	7/2/2019	21	Soybean	6	0.00068	0.05%	102	94	46 – 100%	2.8	1.5
2019	Dr. Reid Smeda	MO	Xtendimax + PowerMax + Impetro II + MON 51817	7/23/2019	9	Soybean	10	0.00106	0.06%	NA	86	45-100%	NA	NA
	Dr. Greg Kruger	NE		8/18/2019	40	Soybean	30	0.09512	0.03%	NA	86	62-100%	NA	NA
	Dr. Steve Li	AL		8/6/2019	5	Soybean	11	4.06223	0.16%	NA	99	34-100%	NA	NA
	Dr. Stanley Culpepper	GA	Xtendimax + PowerMax + Intact + MON 51817	9/10/2019	8.3	Bare ground	0	0.33491	0.08%	NA	97	74-100%	NA	NA
	Dr. Rodrigo Werle	WI		7/14/2019	8	Soybean	16	0.35843	0.12%	NA	92	32-100%	NA	NA

NA = data not available

[1] Peak flux value from post-application air sampling periods.

[2] Surface soil temperature data from site meteorological station.

[3] Based on data from flux meteorological station.

[4] 95th percentile air concentration at 5 m from edge-of-field, 24 hr averaging, based on PERFUM modeling. All values are below the NOAEC of 138 ng/m^3 as submitted in MRID 50578901 and reviewed by EPA in EPA-HQ-OPP-2016-0187-0967.

[5] 90th percentile dry deposition at 5 m from edge of field, 24 hr averaging, based on AERMOD modeling and all values well below the vegetative vigor endpoint NOAER of 29.1 $\mu g/m^2$.

[6] Average relative humidity in the first 24 hours (3 sampling periods) after spray application.

Dicamba Volatility Not Affected by Multiple Growth Stages, Canopy Types and Plant Heights

Monsanto and academic scientists have conducted studies for a range of conditions, including pre- and post- emergent applications. Post-emergent applications on cotton at an 11-inch height, and soybean applications at multiple growth stages with plant heights ranging from 4 to 30 inches have been tested.

Off-target air concentrations predicted from pre-emergent (bare ground) and post-emergent applications over various canopy heights fit within EPA's risk assessment with a large margin of safety (Figure 2). Volatility remains inconsequential across a broad and representative range of growth stages and canopy heights, as evidenced by the observed lack of correlation (Figure 2A).

Dicamba Volatility Unaffected by Key Environmental Conditions

In studies conducted by Monsanto from 2015 through 2019, volatility potential was assessed following applications made in early May, early- to mid-June, July, and in October. Collectively, these studies represent a wide range of relevant environmental conditions, including:

- air temperatures (81 °F to 106 °F)
- soil temperatures (106 °F to 155 °F)
- relative humidity (19% to 100%)

Soil temperature, air temperature, and relative humidity were not correlated with off-site air concentrations in any of the field studies conducted to-date. As illustrated in Figure 2, predicted off-target air concentrations measured from both pre-emergent (bare ground) and canopy applications over a broad range of temperature and humidity conditions are consistently below the refined NOAEC of 138 ng/m^3 (MRID 50578901) and well within the risk assessment, providing a large margin of safety.

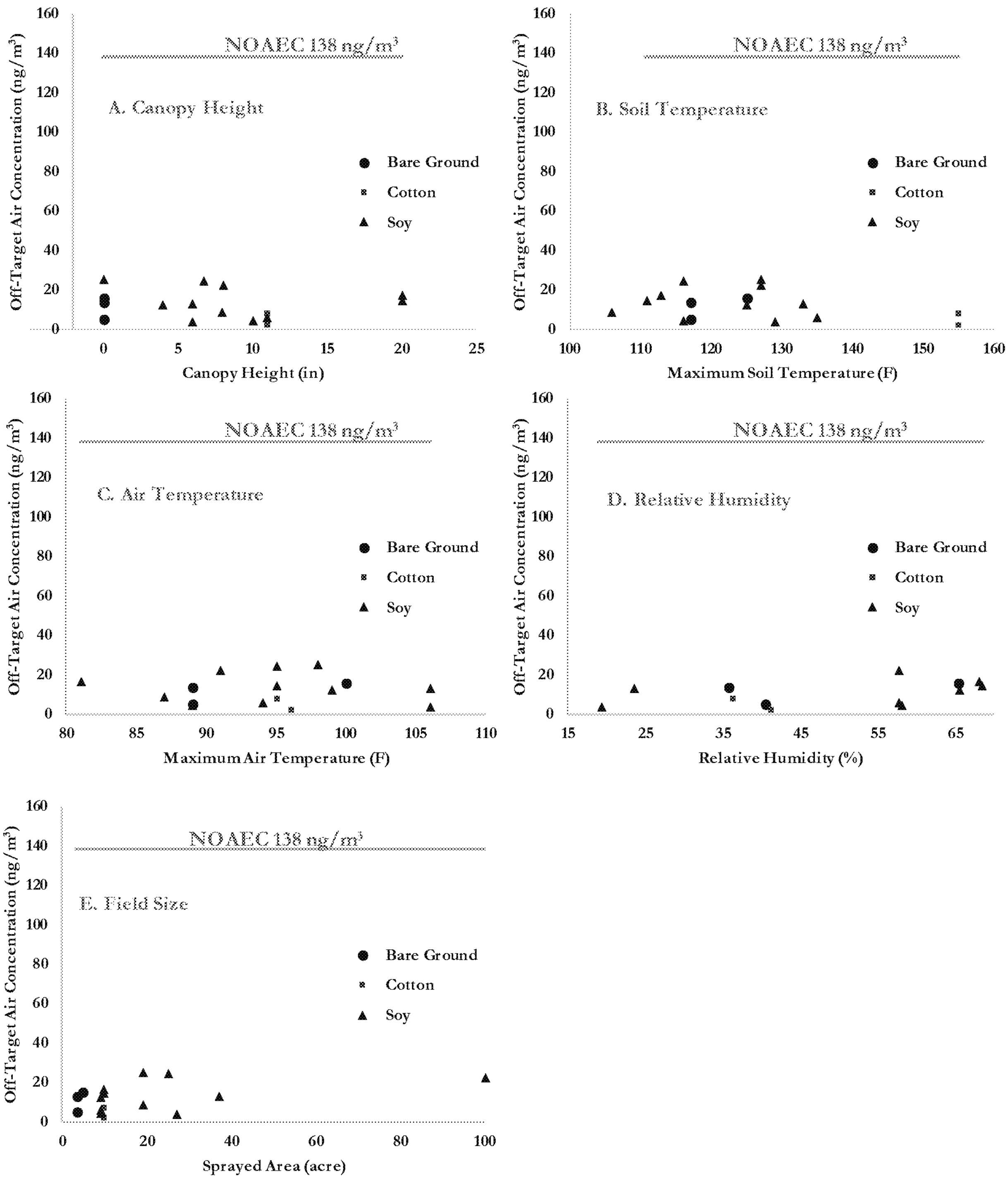

Figure 2.Impact of environmental and field conditions on predicted off-target air concentration in 16 Monsanto submitted studies[3].

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[3] *Academic studies not included because environmental data during these studies was not available.*

Off-Target Air Concentrations of Dicamba Following Application of an XtendiMax-Glyphosate Tank Mixture Are Within EPA's Risk Assessment

As shown in Table 1, Monsanto has submitted to the EPA 12 field volatility studies with XtendiMax and Roundup PowerMax (glyphosate) as a tank mix and demonstrated that the resulting predicted off-target air concetrations are well within EPA's risk assessment. This body of evidence shows that a recent journal article (Mueller and Steckel, 2019, Weed Technology, 33(4):541-546) that finds, based on humidome data, that adding glyphosate to XtendiMax lowers spray mixture pH, and correlates lower pH with higher dicamba air concentrations, is not reflective of real-world off-target movement potential. This is consistent with established scientific understanding that humidome data is primarily useful for relative comparisons and that it is not appropriate to extrapolate the conclusions derived from a humidome study to the field. Instead, a higher-tiered field study is necessary to account for effects of pH in the environment, which Monsanto has provided to the EPA across key soybean and cotton growing states and under real world source water and soil pH conditions (Figure 3).

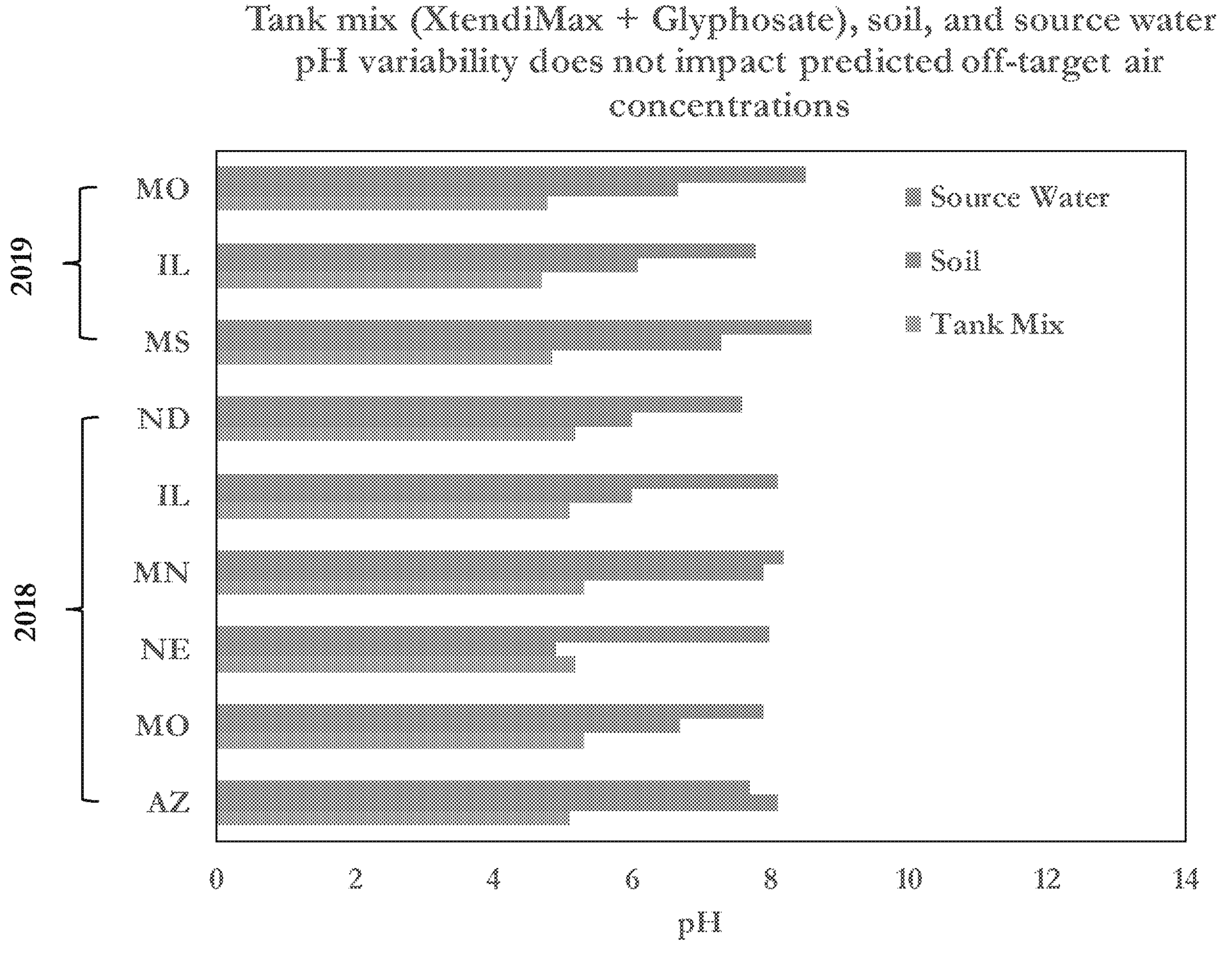

Figure 3. XtendiMax and glyphosate tank mix pH along with corresponding soil and source water pH as measured across nine field studies does not correlate with predicted air concentrations as shown in Table 1

Large Acreage Does Not Meaningfully Increase Dicamba Volatility

Field volatility studies (post-emergent) have been conducted on soybean field sizes ranging from 5 to 100 acres. Flux values and modeling results from these studies demonstrate that sprayng XtendiMax over larger areas (up to 100 acres) does not meaningfully increase dicamba off-site air concentration (Figure 2E). As illustrated in Figure 2E, off-target air concentrations estimated from studies conducted on a range of field sizes are within EPA's risk assessment with a large margin of safety.

Flux Confirmed Using Three Independent Flux Methods

For field studies conducted in 2018 and 2019, Monsanto added an additional flux calculation method that uses measured air concentration from outside of the application area throughout the study. As a result, flux was estimated using three independent methods:

- Aerodynamic (AD)
- Integrated Horizonal Flux (IHF; only used for fields without canopy closure)
- Indirect method

Across the nine studies, there is agreement in calculated flux values (Figure 4). Alignment across multiple flux methods provide additional confidence in flux values that were generated in studies prior to 2018.

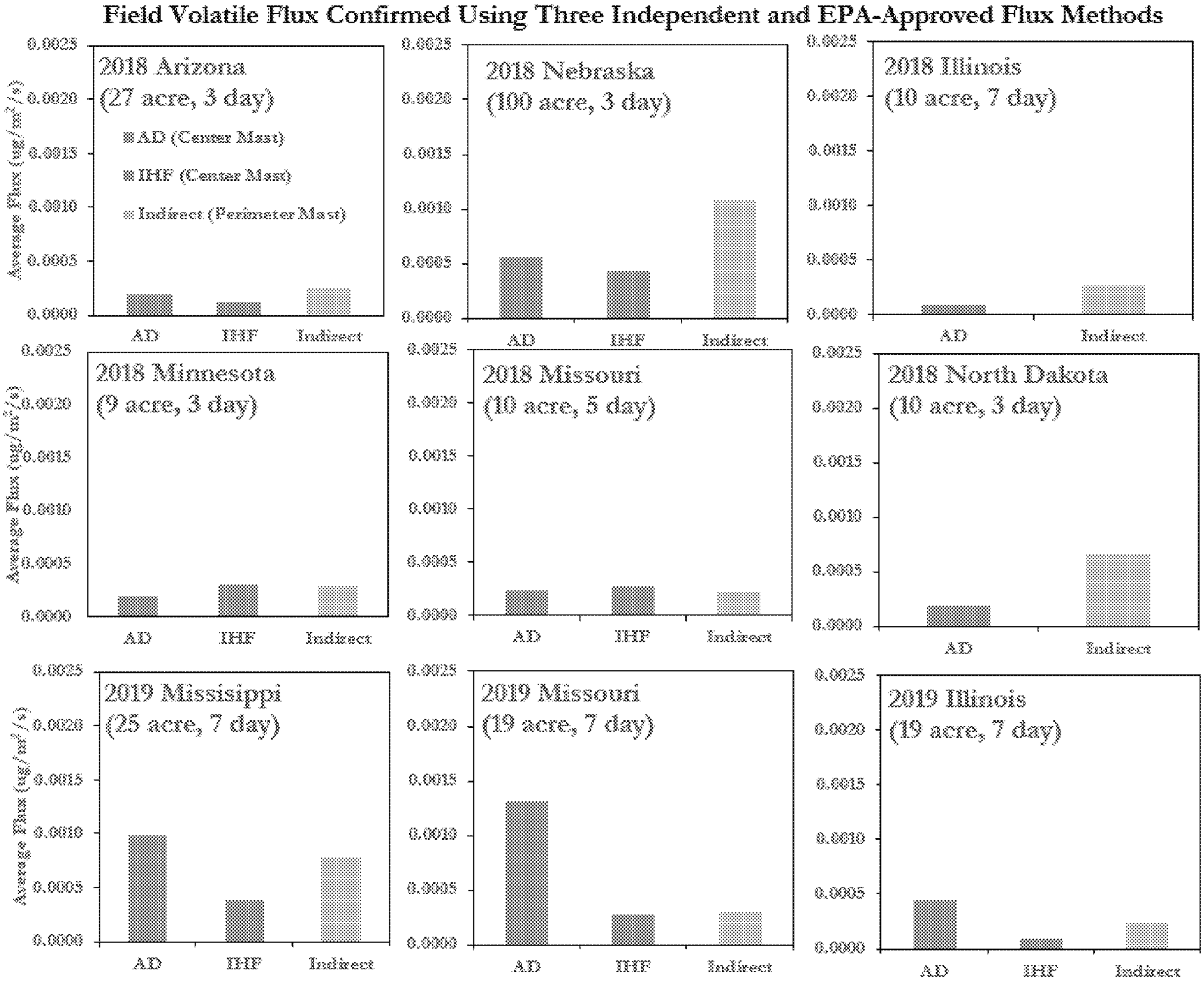

Figure 4: Agreement in flux values using air concentration data from center mast and perimeter mast air concentration[4].

Modeled Off-Target Air Concentration and Vapor Deposition Protective of Sensitive Non-Target Species

Off-target air concentrations at 5 m from the edge of the field were estimated using the PERFUM2 model, using a conservatively estimated 24-hour flux profile and meteorological inputs for three representative locations. Note that the PEFUM2 modeling adds additional conservatism by looking for the worst-case dispersion conditions during the growing season to generate the 95th percentile air concentrations. For studies conducted from 2015 to 2018, the maximum predicted 95th percentile 24-hour average air concentration of dicamba at 5 m from edge of field ranged from 2.4 ng/m^3 to 22 ng/m^3. For the 2019 condition of registration studies, the maximum predicted 95th percentile 24-hour average air concentration of dicamba at 5 m from edge of field was 9.0 ng/m^3 (IL), 24.3 ng/m^3 (MS), and 25.2 ng/m^3 (MO). These off-target air

[4] IHF flux was not calculated for 2018 Illinois and 2018 North Dakota studies due to canopy closure.

concentrations are all significantly less than the no-observed-adverse-effect-concentration (NOAEC 138 ng/m^3; MRID 50578901) and thus will not result in plant height reductions greater than 5 percent to non-target species. In addition, predicted off-target air concentrations are below the 5% visual symptomology threshold of 31.2 ng/m^3 (MRID 50578901) and are consistent with studies conducted from 2015 through 2018 (Figure 5).

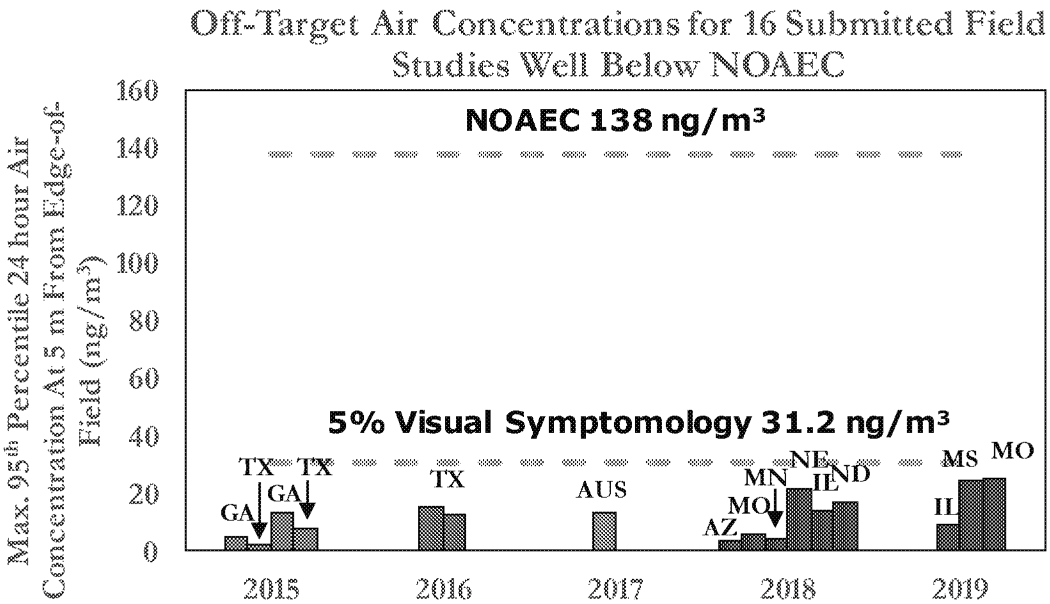

Figure 5. Off-target simulated air concentrations from PERFUM2 model for 16 Monsanto field studies well below NOAEC and below 5% visual symptomology[5].

Similarly, off-target vapor deposition was estimated with AERMOD model, using a conservatively estimated 24-hour flux profile from the volatile flux estimations and meteorological inputs for the same three representative locations. For studies conducted from 2015 to 2018, the maximum predicted 90th percentile 24-hour total dicamba deposition values ranged from 0.997 µg/m^2 to 6 µg/m^2. In 2019, the maximum predicted 90th percentile 24-hour total dicamba deposition values were 2.1235 µg/m^2 (IL), 4.6209 µg/m^2 (MS), and 5.0230 µg/m^2 (MO). These off-target air deposition values are significantly less than the vegetative vigor no observed effect rate (NOAER 29.1 µg/m^2; MRID 47815101) and are consistent with the results of studies conducted from 2015 through 2018 (Figure 6). This was also confirmed by spray drift deposition collected in the field on filter paper following periods after spray application (i.e. 1 hour after application completed). The data showed that estimated distance to reach no-effect levels were < 3 m. Note: The <3 m distance was used as a surrogate because the models used to fit the deposition data sometimes could not resolve for distances less than 3 m, which was the nearest measurement distance.

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[5] PERFUM2 modeling data from academic studies is unavailable.

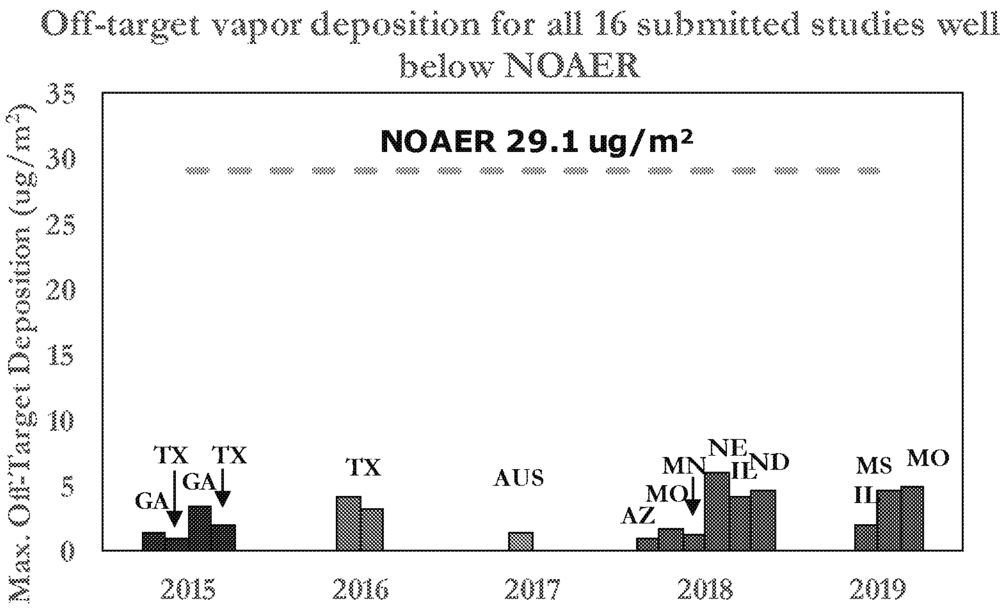

Figure 6. Simulated off-target vapor deposition from AERMOD model for 16 Monsanto studies well below NOAER[6].

Site-Specific Air Dispersion Modeling Confirms Flux Estimates

To validate the flux estimates and associated off-target air concentrations derived from other field volatility studies, Monsanto conducted additional air and meteorological sampling during four field studies: Arizona (2018), Mississippi (2019), Illinois (2019), and Missouri (2019). Additional perimeter air sampling was conducted throughout the study at 5 m from edge-of-field and in 8 directions. In addition to the standard surface level meteorological data, wind speeds and air temperature measurements were collected at 5 and 10 m heights. Air concentrations and meteorological data collected from the sprayed field was used to derive a 64-hour aerodynamic flux profile per EPA guidelines. This 64-hour flux profile and corresponding meteorological data was input into EPA's AERMOD air dispersion model to simulate the air concentrations at the eight locations of the perimeter sampling and for 6 sampling periods. As illustrated in Figure 7, the flux estimates from AD adequately captured the on-field volatilization and, therefore, produced off-field modeled air concentrations that were consistent with measured air concentrations. Collectively, these results demonstrate the utility of the flux calculation and air dispersion methods for accurately representing off-target movement of vapor-phase dicamba.

Additionally, although air dispersion models are robust tools for predicting site-specific off-target air concentration, as described above, to add further conservatism to the risk assessment, the following measures are taken: (a) the flux profile

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[6] AERMOD modeling data from academic studies is unavailable.

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input to the air dispersion model is based on selecting maximum of the three flux models (Aerodynamic, Integrated Horizontal Flux, and Indirect), and (b) this conservative flux profile is then assumed everyday during the model run to identify the worst-case environmental conditions. Figure 5 shows the air concentrations using this accurate and conservative approach can be used with a high degree of confidence for the purposes of risk assessment.

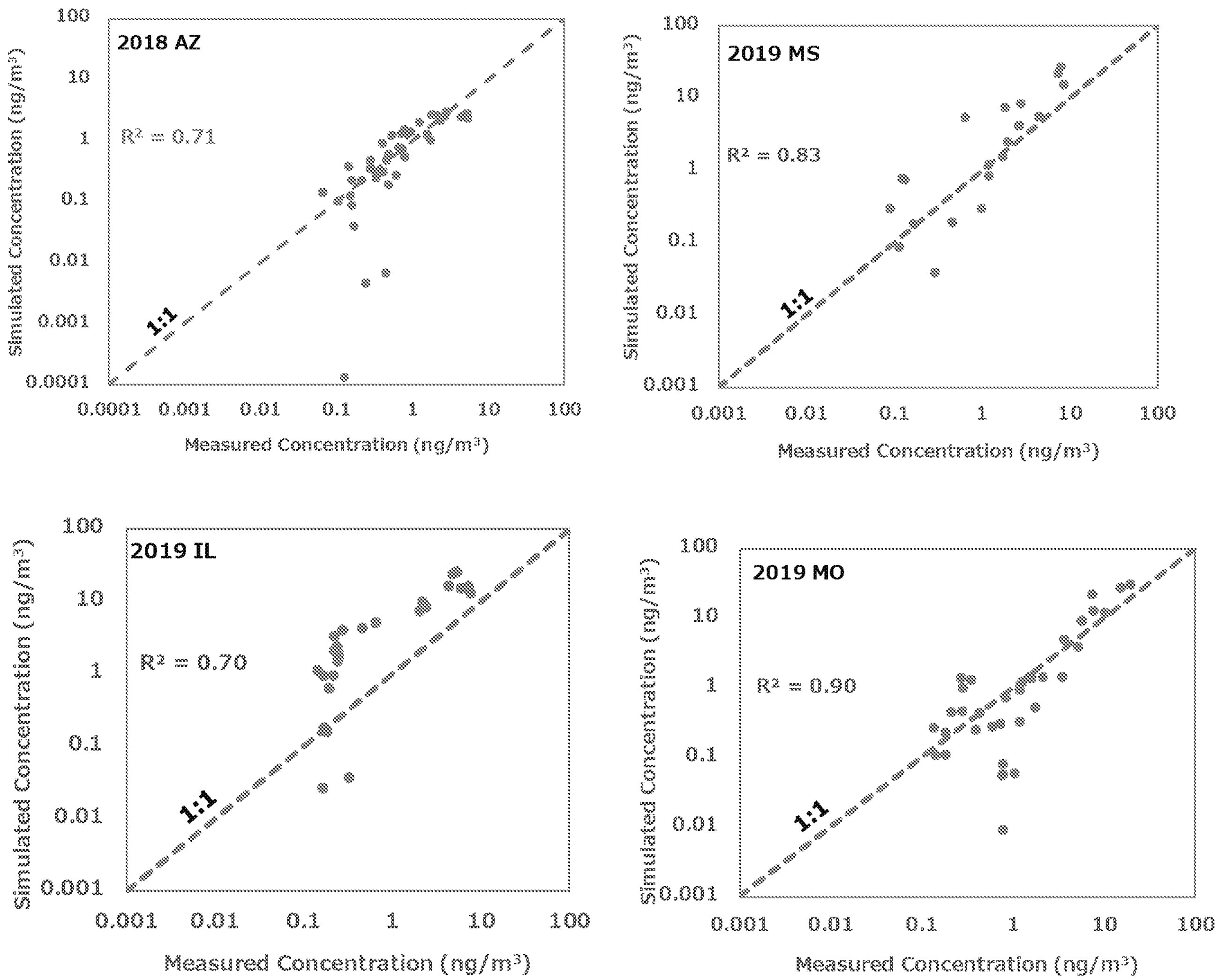

Figure 7: EPA recommended flux and air dispersion models provide robust estimates of off-target air concentrations and were confirmed in four field studies

2019 Monsanto Field Study Results Are Consistent with EPA's Conclusion that Existing Downwind Buffer Is Protective of Spray Drift Deposition

As part of the 2018 XtendiMax conditions of registration, in 2019, field studies located in MS, IL, and MO evaluated spray drift deposition in all directions, totalling nine transects, by placing filter paper during the spray application for up to 1 hour after application. The three most downwind transects, based on wind direction during the spray application, were selected to estimate the buffer distance to reach the NOAEC levels. The average buffer distances for the selected downwind transects were 29.6 m (MO), 4.7 m (IL), and 11.2 m (MS), which are consistent with XtendiMax label's downwind buffer requirement of 33.5 m (110 ft).

After the first hour, filter papers were placed along the same nine transects in 24-hour increments for the duration of the study. Results showed that the dicamba deposition on filter paper after 24 hours was a minor component of the total deposition during the study, further confirming that peak volatility occurs during first 24 hours only (Figure 8).

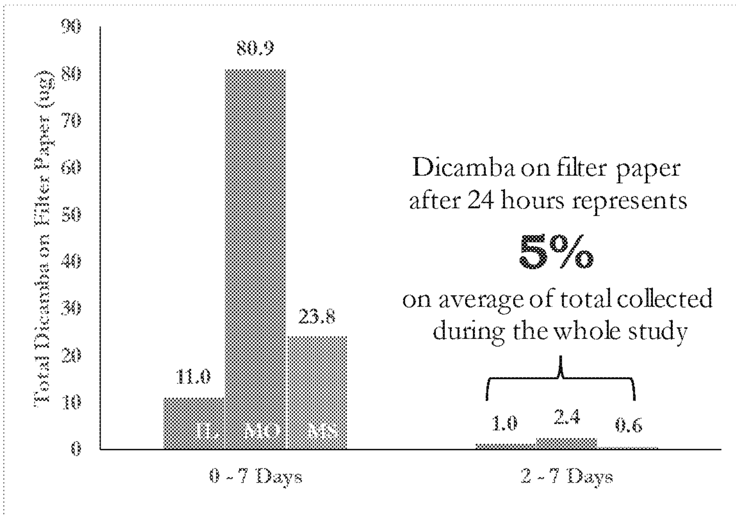

Figure 8. Off-target deposition after 24 hours is a minor component of overall off-target deposition

Non-Downwind Locations Were Not Exposed to Measurable Spray Drift or Volatility

Additionally as part of the 2018 conditions of registration, spray drift deposition was evaluated in the non-downwind direction by placing filter paper during the spray application and up to 1 hour after. None of the studies showed any measureable spray drift deposition in non-downwind locations. In addition, no-effect distances to plant height reduction were 0 m in all other directions, indicating the primary route of off-target movement was from spray drift in the downwind direction at the time of spray application.

Existing Buffer Is Protective to the No-Effect Distance for Plant Height Due to Spray Drift

Data from field trials conducted in 2018 and 2019 by Monsanto as well as academic researchers are consistent with EPA's conclusion that the existing 110-foot downwind buffer is sufficient to protect off-target plants from adverse effects. For example, Monsanto conducted a field trial in 2018 in Arizona that evaluated the effects on plant height. The data from that trial indicated no effects from drift to soybean plant height outside the treated area. Following a similar study design in their field trials, the maximum distances to 5% reduction (i.e., no-effect) in height for three 2018 field studies conducted by academics were 9 m (Dr. Werle - WI), 10 m (Dr. Sprague - MI), and 12 m (Dr. Kruger - NE).

The 2019 condition of registration field studies also evaluated plant height effects on soybean that were exposed to dicamba spray drift during application. In these studies, plant height was expected to increase linearly with distance away from the spray, then plateau. This plateau, determined from nonlinear regression modeling, occurred at the no-effect distance, beyond which the level of dicamba exposure was not sufficient to impact plant growth. Transects that did not exhibit this exposure-response relationship were assessed visually to determine a distance to no-effect. It is important to note that the no-effect distance established for effects on plant height that were determined visually (i.e., lack of fit) is dependent upon the evaluation distances downwind from the sprayed area (e.g., 3, 5, 10, 20, 40, 50, 60 and 90 m) and the actual no-effect distance likely falls between the shortest distance with no effects (NOAEC) and longest distance displaying effects (LOAEC). In the Illinois study, the no-effect distance for plant height in the downwind transects (6 transects) ranged from 10 m to 40 m; however, the transect with the estimated no-effect distance at 40 m was based on a visual assessment, and based on study design, there were no plant effect measurements between distances of 20 m and 40 m. Therefore, it is assumed that the actual maximum no-effect distance is likely between 20 m and less than 40 m.

In the Mississippi study, there was a drenching rain (4.9 inches over several hours) within 28 hours of application that resulted in pronounced pooling in specific areas of the field used to assess drift and volatility (Figure 9). Therefore, the no-effect distances for plants in those portions of the field (3 downwind and 1 upwind transects) that were impacted by standing water and subsequent movement of dicamba cannot be reliably used to assess effects due to drift and volatility. For the remaining transects that were determined to be downwind at the time of application, there was no evidence of impacts to plant height due to drift beyond the buffer distance (no-effect distances ranged from 10 m to 20 m. In Missouri, due to other factors unrelated to dicamba—namely the weather, late-season planting and the photosensitive nature of soybeans—the no-effect distances for plant height could not be assessed. Specifically, the lack of growth in the control plants between 14 DAT and 28 DAT demonstrated soybean plants were not growing normally; therefore, comparisons of plant heights were unreliable and were not conducted.

Figure 9. MS Field conditions following the storm event showing flooded field and soybean plants covered with soil residue

Off-field Dicamba Air Concentrations In 2019 Academic Studies Are Within EPA's Risk Assessment

For the 2019 academic studies, in addition to the in-field air samplers, four off-field air samplers were placed at 50 feet from edge of field 22" above the canopy measured air concentrations for up to 3 days after application[7] and seven sampling periods. Sampling durations during these periods ranged from approximately 3 to 17 hours. During the first three sampling periods, which accounted for approximately the first 24 hours, the in-field air concentrations ranged from 0.9 to 53 ng/m^3. The remaining sampling periods, representing days 2 and 3, produced in-field air concentrations between 0.2 to 5.1 ng/m^3. Similarly, off-field air concentrations for first three sampling periods ranged from 0.1 to 38 ng/m^3. The next four sampling periods, representing days 2 and 3, produced off-field air concentrations ranging from 0.9 to 3.6. ng/m^3.

Overall, these results indicated that: (a) off-field measured air concentrations are expected to be lower than in-field measured air concentrations, (b) in-field concentrations reduced significantly after the first 24 hours (periods 1-3), and (c) all measured air concentrations were lower than the refined NOAEC of 138 ng/m^3 (MRID 50578901) and well within the risk assessment, providing a large margin of safety.

[7] The Wisconsin study had four additional off-field air samplers placed mid-edge 100 feet from the field edge.

Effects Studies To Date Indicate That Soybean Plant Height Is An Appropriate Endpoint for Risk Assessment

EPA typically uses the no observed adverse effect concentration (NOAEC) associated with the most sensitive species' EC25 value as the effect threshold to determine whether exposure has the potential to cause risk to listed plant species. These thresholds are normally developed from measurements of apical endpoints (*e.g.* plant height, biomass) in laboratory studies and for dicamba the listed species endpoint (NOAEC = 0.00026 lb a.e. dicamba/A) used in EPA's risk assessment was based on soybean plant height.

As part of the 2018 XtendiMax conditions of registration, EPA requested non-guideline ecological studies, including ecological effects data on effects to yield for sensitive soybeans at different growth stages and growing regions and effects to non-soybeans species (i.e, sensitive tree/shrub/woody perennial species).

Yield Studies

EPA requested that Monsanto conduct studies that assessed whether plant height is a surrogate that is protective of yield for ecological risk assessment. Soybean yield trials were performed in three locations in 2019: Greenville, Mississippi; Fisk, Missouri; and Stewardson, Illinois. These studies represented varied geographic areas with a range of environmental conditions (e.g., temperature and humidity) and included states where a significant portion of 2019 inquiries into off-target movement were recorded.

The purpose of these studies was to evaluate potential effects of mixtures of low rates of dicamba (Clarity®) when tank mixed with glyphosate (Roundup PowerMax®) on soybean yield relative to effects on plant growth at two different growth stages: vegetative and reproductive. The soybean varieties chosen for the studies were selected based on geography, and were tolerant to glyphosate but were not tolerant to dicamba. Soybeans were exposed to mixtures of dicamba, ranging from 0.0003 – 0.0048 lb a.e./A, and glyphosate, ranging from 0.000675 – 0.0108 lb a.e./A. Soybean plants were visually assessed for morphological changes and plant height was measured at 0, 14, and 28 days after treatment (DAT) and yield data were collected at maturity. Data pertaining to plant height at 28 DAT and yield at maturity are presented here.

Plant height and yield provide similar and confirmatory end points

Overall, the results of the soybean studies confirmed that the plant height endpoint is more sensitive than effects on yield. As shown in Table 2, NOAEC values for plant height are more sensitive (lower) than yield for both growth stages studied (vegetative and reproductive). In addition, both the NOAEC used for listed species and the EC25 used for non-listed species are more sensitive than the NOAEC and EC25 values for vegetative and reproductive growth stage from three field studies.

Table 2. NOAEC and EC25 for Dicamba[1] for Studies in Mississippi, Missouri, and Illinois. The listed species endpoint (NOAEC) for plant height is lower than the yield NOAEC. All endpoints are higher than the EPA listed and non-listed species risk assessment endpoint (NOAEC and EC25) from the laboratory studies.

Study Location	MRID	Vegetative Experiment				Reproductive Experiment			
		Plant Height 28 DAT		Yield		Plant Height 28 DAT		Yield	
		NOAEC	EC25	NOAEC	EC25	NOAEC	EC25	NOAEC	EC25
Mississippi	51017504	0.0003	0.0021	0.0012	0.0211	<0.0003	0.0016	0.0012	0.0062
Missouri	51017506	0.0003	0.0015	0.0048[2]	NE[3]	0.0024	0.0080[4]	0.0048[2]	0.0058[4]
Illinois	51017505	0.0003	0.0014	0.0006	0.0011	0.0006	0.0044	0.0012	0.0021

[1] Treatment rates expressed as lb dicamba a.e./A.
[2] Highest treatment rate.
[3] NE = Not estimated due to poor fit of concentration-response model.
[4] Extrapolated value.

Endpoints derived from laboratory effects studies are protective of endpoints in the field

The field effect studies confirmed that soybean plant height is protective of effects on yield. Additionally, the dose-response relationship between soybean plant height and dicamba application rate from guideline laboratory studies confirm the current regulatory endpoint based on soybean plant height (NOAEC = 0.00026 lb a.e. dicamba/A) is protective of field effects and provides an additional level of conservatism in the risk assessment (Figure 10).

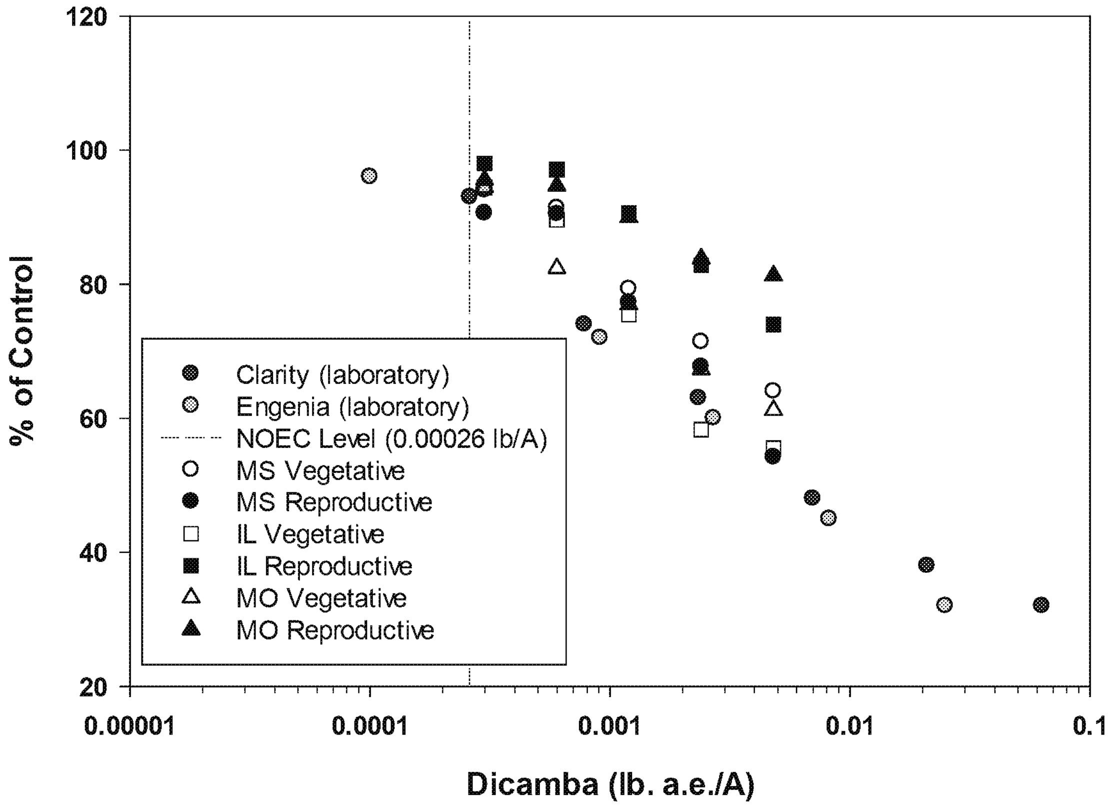

Figure 10. Comparison of laboratory plant height data to field generated effects data.. Red and green circles show laboratory plant height data for different dicamba doses. White and black circles, squares, and triangles show field plant height data in different growth stages, locations, and dicamba doses. Overall, field plant height data is less sensitive than laboratory data, indicating that laboratory-generated end points are protective of field effects.

Tree Study

As part of the 2018 XtendiMax conditions of registration, EPA requested additional studies that evaluate ecological effects of dicamba exposure to non-target plants, related to survival and growth of select sensitive tree/shrub/woody perennial species. During the planning phase of the study, a tiered testing approach was developed in coordination with EPA in which Monsanto conducted initial screening studies (tier I) followed by full dose-response studies (tier II) for only those species found to be potentially more sensitive to dicamba relative to soybean. The initial screening study (MRID 51017507) was conducted on five tree species—sycamore (*Platanus acerifolia*), apple (*Malus domestica*), cherry (*Prunus avium*), swamp cypress (*Taxodium distichum*) and red oak (*Quercus rubra*)—to evaluate the effect dicamba exposure on growth, plant development and morphology.

The tier I study was conducted as a limit test where a single application of the test item, applied at a rate of 0.000513 lb dicamba a.e./A (Clarity® formulation) with 0.125% adjuvant, along with both an adjuvant control and a water-only control were made to five tree species. The application rate used in the study represents the EC25 value for soybean. Assessments were made 14, 28, 45, 60 and 90 days after application (DAA). On all assessment days plant length, visual phytotoxicity and axillary branch growth were recorded. At the final assessment (on day 90 after application), plant dry weight was determined.

Sycamore, apple and cherry met the validity criterion of at least 90% for survival in the control. The control trees for each species did not exhibit visible phytotoxic effects during the study duration and showed normal variation in growth, plant development and morphology. However, for red oak and swamp cypress, the initial study did not meet the validity criteria for the control trees. As a result, a second study was conducted. In the repeated study, the trees in the control group for both species met the validity criterion and showed normal variation in growth, plant development and morphology.

The results of the tier I tree study confirmed that four tree species—sycamore, apple, cherry and swamp cypress—are less sensitive to dicamba than soybean (effects <25%) after exposure to dicamba at a rate of 0.000513 lb a.e./A under greenhouse conditions. Specifically, at the conclusion of the 90-day evaluation period in the tier I studies, except for red oak, none of the trees exhibited >25% effect on plant height or dry weight due to the dicamba application rate of 0.000513 lb a.e./A (Table 3). All tree species, including red oak, exhibited normal axillary branch growth in all test groups.

For red oak, effects in the screening tier I study exceeded the 25% effect trigger for a tier II study; however, this exceedence does not necessarily indicate that red oak is more sensitive than soybean, but rather a full dose-response tier II study is required to understand the effect of dicamba on the species. The dose-response study tier II study will derive a EC25 value for red oak that will be directly compared to soybean. Monsanto expects to complete the tier II study by the summer of 2020.

Table 3. Effects of dicamba on the phytotoxicity, height, and dry weight to five tree species following 90 day after application.

Species	Phytotoxicity (% and symptoms)		Plant length# (% inhibition) N		Plant dry weight (% inhibition) N	
	Adjuvant control	Test item	Adjuvant control	Test item	Adjuvant control	Test item
Sycamore	0.0	0.8 a	1.9	6.4	5.0	0.1
Apple	0.0	1.5 a	**21.6**	**18.2**	2.8	9.1
Sweet cherry	0.0	1.5 abd	-2.6	1.0	-0.1	2.4
*Red oak**	1.8 abd	14.3 abd	3.0	**34.7**	-6.1	10.8
*Cypress**	0.0	0.8 f	-17.8	-3.7	-36.2	-36.4

N A negative value indicates an increase compared to the control.
Plant length is calculated taking the initial plant length one day before the application into account.
* Data have not been QA reviewed
Bold figures are statistically significantly different to the water control (Student-t test for Homogeneous Variance; one sided smaller; $p \leq 0.05$).

Codes for phytotoxic symptoms:
a = chlorosis (yellowing of green shoot tissue)
b = necrosis (e.g. brown shoot tissue, parts of the plant die)
d = deformation/epinasty (e.g. leaf curl, abnormal leaf shape, abnormal plant habitus)
f = reddening (reddening of green shoot tissue)

Field Runoff Following an Irrigation Event Is *De Minimus*

As part of the 2018 XtendiMax conditions of registration, EPA requested a dicamba runoff irrigation study to evaluate the effects of dicamba-containing agricultural irrigation water on non-target plants. Thus, a field irrigation runoff study (MRID 51017508) was conducted to determine the levels of dicamba in intentionally generated runoff water during the first furrow irrigation event following an application of a dicamba formulation (Clarity; EPA Reg. No.: 7969-137) to dicamba tolerant (DT) soybeans under field conditions. The selected site was in a commercial soybean production region (Butler County, MO) which utilizes furrow irrigation practices.

A single broadcast application at a target rate of 560 g dicamba acid equivalent (a.e.)/ha was made during the V2 growth stage. The timing of this application relative to the crop growth stage and irrigation timing is considered highly conservative for runoff potential, as there is minimal canopy coverage and typically furrow irrigation is not necessary until the R1 to R3 growth stages. Furrow irrigation was applied to one of the treated plots (Treated Plot 1, T1) 2 days after application, and second furrow irrigation event was applied to the second treated plot (Treated Plot 2, T2) 7 days after application. Runoff samples were collected with autosamplers every 11 minutes for the first hour, every 31 minutes for the second hour, and then hourly until runoff stopped or was determined to be insignificant.

Dicamba Runoff Concentration Sharply Declines After First Runoff Event

The initial runoff samples collected just after runoff began (first 11 minutes) had the highest concentrations, and the average peak concentration in treated plot 1 (423 μg/L) was approximately 11% higher than in treated plot 2 (382 μg/L; Figure 11). Dicamba concentration in runoff water fell off sharply at following sampling intervals. The second samples, collected 11 minutes after the initial samples, had significantly lower concentrations (169 μg/L and 129 μg/L in T1 and T2, respectively). In each replicate plot, sample concentrations tended to decrease sharply over time, and the average concentrations became very low at the end of the irrigation event (30.6 μg/L in T1 and 8.63 μg/L in T2).

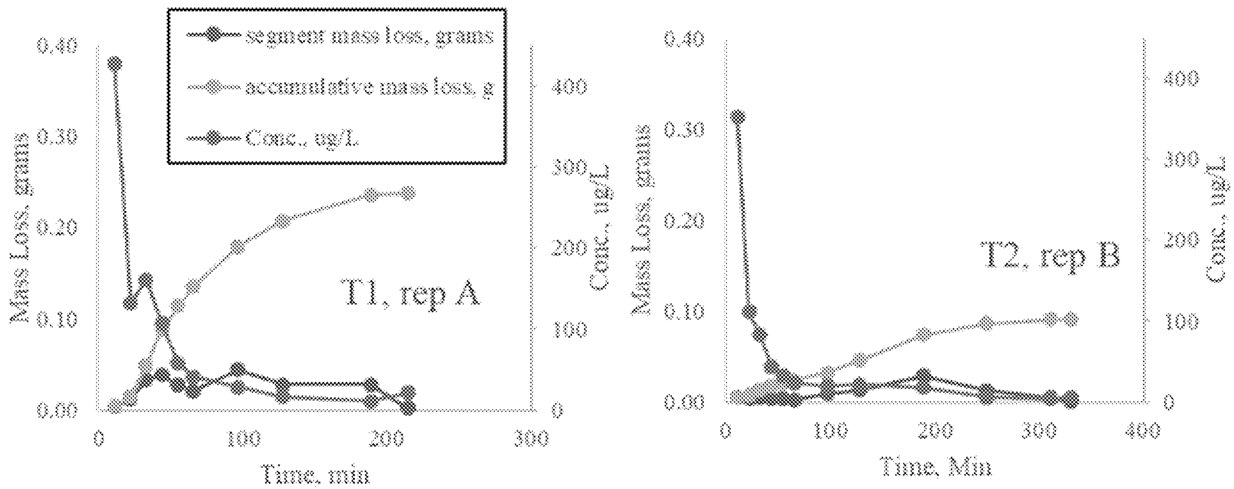

Figure 11. Dicamba Residue Concentration and Mass Loss in Runoff from Plots T1 and T2

Under Highly Conservative Conditions, Dicamba Mass Loss in Runoff Following an Irrigation Event Is De Minimus

Due to very wet conditions in the spring and early summer in Midwest and several rain events on the field prior to the irrigation event, soil moisture levels were high. Volumetric water content averaged 0.21 and 0.14 on plots for the first irrigation event (T1) and the second irrigation event (T2), respectively, which were consistent with wet conditions observed, thus maximizing runoff and minimizing infiltration from the irrigation event. In addition, the timing of the irrigation relative to the crop growth stage (V2) was considered highly conservative for runoff potential, as there was minimal canopy coverage and furrow irrigation typically is not necessary until the R1 to R3 growth stages. The total mass lost in treated plot 2 (0.07% to 0.19% of applied) was generally less than that lost in treated plot 1 (0.19% to 0.32% of applied). The average mass loss as a percent of the applied in treated plot 2 (0.12%) was approximately half the average mass loss in treated plot 1 (0.25%; Figure 12).

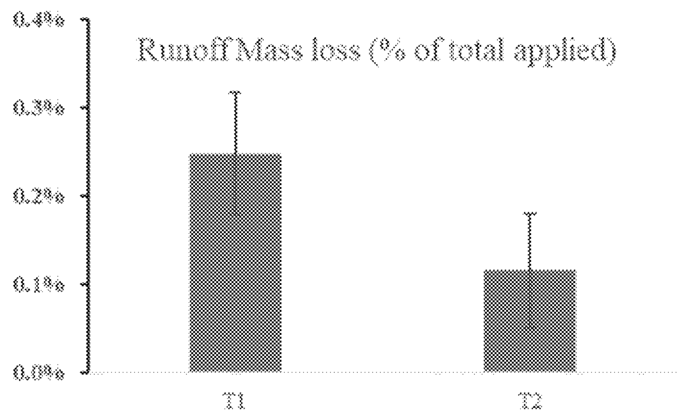

Figure 12. Total Dicamba Mass Loss in Each Treated Plot

Dicamba in Runoff Does Not Cause Risk to Non-Target Species

Dicamba exposure to terrestrial and semi-aquatic plants was estimated using the screening level TerrPlant Model (version 1.2.2). The model generates estimated exposure concentrations (EECs) for plants residing near a use area that may be exposed via runoff. The effects of runoff to soybean, the most sensitive endpoint from the non-target plant studies, was evaluated by comparing the EECs generated from a single application at the maximum single use rate (1.0 lb a.e. dicamba/A) and the total dicamba mass loss from the first irrigation event (0.25%). Applying these conservative assumptions resulted in RQs below the LOC (1.0) (Table 4).

*Table 4. RQ values calculated in TerrPlant for dry and semi-aquatic areas exposed to Dicamba DGA salt through runoff**

RQ Values for Plants in Dry and Semi-aquatic Areas Exposed to Dicamba Through Runoff and/or Spray Drift

Plant Type	Listed Status	Dry	Semi-Aquatic
Monocot	non-listed	<0.1	<0.1
Monocot	listed	<0.1	<0.1
Dicot	non-listed	0.10	0.28
Dicot	listed	0.19	0.52

*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.
Conservative assumptions of 1 lb a.e./A application rate (total permitted in a single in-crop application, per label requirements) and 0.25% loss through runoff and erosion.

The highest dicamba residues were detected in the first 10 to 20 minutes, and then the residue concentration declined dramatically to a very low level at the end of irrigation event. The dicamba mass loss reached a plateau towards the end of the irrigation event. The total dicamba mass loss was 0.25% (irrigation at 2 days after application) and 0.12% (irrigation at 7 days after application) of applied, respectively. Using the most conservative total mass loss estimate and the maximum in-crop application rate (1.0 lb a.e./A) is below the Level of Concern (LOC).

Humidome Studies Are Useful for Relative Comparisons, but Do Not Predict Dicamba Off-Target Movement Potential in the Field

EFED requested a dicamba humidome (closed dome system) study to assess the relative effects of temperature, relative humidity, and pH on the dicamba volatility potential of XtendiMax over the first 24 hours after application[8]. A full factorial study design (MRID 51017509), consisting of 27 humidomes, that included three pH (4, 5.17, 6.36), three temperature (30°C, 35°C, and 40°C) and three relative humidity (40%, 50%, 60%) combinations were used to span the maximum range of the environmental chamber capabilities and typical pH conditions. Dicamba was captured on Polyurethane Foam (PUF) material, extracted, and quantitated using Liquid Chromatography Mass Spectrometry-Mass Spectrometry (LCMSMS). The main conclusions from this study are presented below.

Temperature Contributes Most to Dicamba Volatility Potential in the Humidome

Temperature was found to account for the largest percent in variance (55%) in amount of dicamba captured on PUFs in the humidome. This is double the contribution of pH (22%) and many times greater than relative humidity (<1%). Temperature and pH together were also found to have a statistically significant effect. From the data, the largest step change in dicamba volatility potential was in the increase of environmental temperature from 35°C to 40°C. Temperature changes from 30 to 35° C had a minimal effect on volatility potential (Figure 13).

Effect of Lower pH Requires Elevated Temperatures

While temperature increases volatility potential at all pH's and relative humidities, pH only increases volatility at higher temperatures. At 30°C, minimal differences are seen across all pH's while at 40°C there is a ~2X increase in volatility potential when moving from pH 5.17 to 4. The slopes of the regression lines between volatility and temperature reduce as pH increases. The two-way interaction of temperature and pH is the third strongest contribution to the variability in dicamba volatility potential in the humidome.

Increasing pH of XtendiMax Has a Minimal Impact on Potential Volatility

Adjusting XtendiMax from pH of 5.17 to pH of 6.36 has a minimal impact on decreasing volatility under label restrictions. Statistically similar volatility potentials were found for 5.17 and 6.36 pHs at lower temperatures and only found to differentiate at 40°C.

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[8] Humidome studies provide valuable information that can be used to generate information related to the relative volatility potential of various conditions, formulations, tank mixes, etc., however, humidome studies are not suitable for providing absolute data that are appropriate for estimating potential off-target movement.

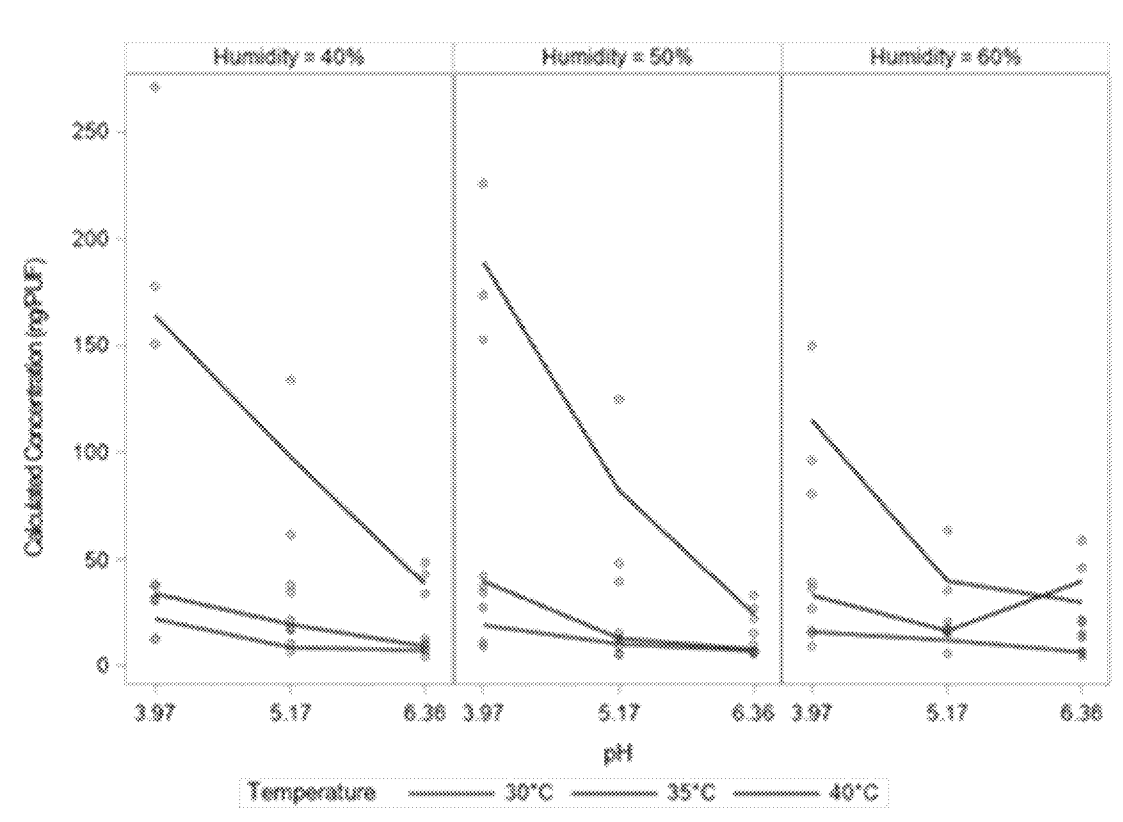

Figure 13. Relationship between dicamba volatilization in a humidome and a range of environmental variables including pH, temperature, and relative humidity.

From these results, temperature was found to have the largest relative effect on dicamba volatility potential of XtendiMax. Decreasing pH was not found to statistically affect volatility potential at 30ºC (86 ºF) and 35ºC (95 ºF). Relative humidity was found to have a negligible effect on volatility within the range of this study. Humidome studies such as this one are useful for relative comparisons and provide valuable information without the complications of environmental variability in the field, however they are lower-tiered studies and thus do not provide realistic estimates of field volatility. Even though temperature was found to have the greatest effect on dicamba's volatility potential in this evaluation, it is not predictive of volatility in the field. Monsanto has conducted higher-tiered field studies under extremely high temperatures and found volatility remains low. Specifically, field studies conducted in 2017 (Australia) and 2018 (Arizona) both had a maximum air temperature of 41ºC (106ºF), yet predicted air concentrations outside of the treated area were well below the NOAEC. Because temperature had the largest relative effect on dicamba volatility in the humidome, and previous field studies demonstrated the lack of adverse effects outside the spray application area at high temperatures, adverse effects would not be expected as a result of the range of pH and relative humidity condtions evaluated in the humidome study.

Tank Mix and Source Water pH Not Predictive of Dicamba Volatilization Potential

Two studies were conducted to evaluate the role of pH on dicamba volatility. The purpose of the first study (MRID 51017511) was to assess the tank mix pH and corresponding air concentration data from humidome studies in which XtendiMax was mixed with an additional tank mix partner. Air concentration and pH data was retrieved from an online third-party database called Collaborative Drug Discovery (CDD) Vault that Monsanto uses to store humidome test results.

The purpose of the second study (MRID 51017510) was to summarize water pH in 34 states where cotton and soybean are grown including AR, GA, IL, MO, ND, TN, MN, NE, AZ, IN, AL, CO, DE, FL, IA, KS, KY, LA, MD, MI, MS, NJ, NM, NY, NC, OK, OH, PA, SC, SD, TX, VA, WV, WI. This data was retrieved from the United States Geological Survey (USGS) Water Quality Portal (WQP; https://www.waterqualitydata.us/) database for February 1898 through April 2019. Water monitoring stations within 1 km of either soybean or cotton growing area were selected. Based on the type of sources available in WQP, data was classified as either Groundwater and Non-Groundwater sources and pH values were aggregated.

Data From 572 Humidome Trials Shows That pH Is Not Correlated With Dicamba Air Concentrations

A humidome data evaluation was conducted with 572 tank mixtures[9] with pH and air concentration measurements stored within the CDD Vault – a third-party database that Monsanto uses to store humidome results. The relationship between pH and dicamba air concentration is shown across the 572 tank mixtures (Figure 14). It is evident that pH is not correlated with dicamba air concentrations. The measured dicamba air concentrations can vary across pH ranges. When the data was classified by tank mix partner type, no correlation between pH and dicamba air concentration was observed and this conclusion remained consistent across all tank mix partner classes (Figure 15).

[9] These tank mixtures were comprised of XtendiMax and prospective tank mix partners that were evaluated for potential inclusion as approved tank mix partners for XtendiMax. Not all of these tank mixtures are enabled on the XtendiMax tank mix website.

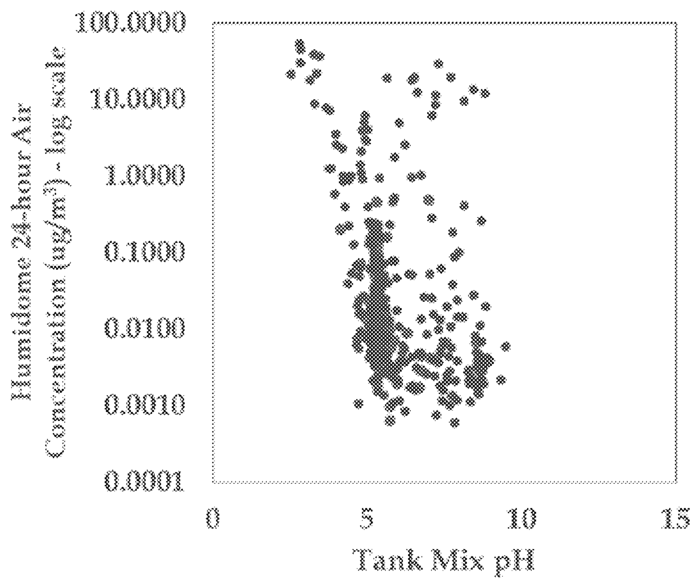

Figure 14. Tank mix pH and dicamba 24-hour air concentration as measured in humidome is not correlated[10]

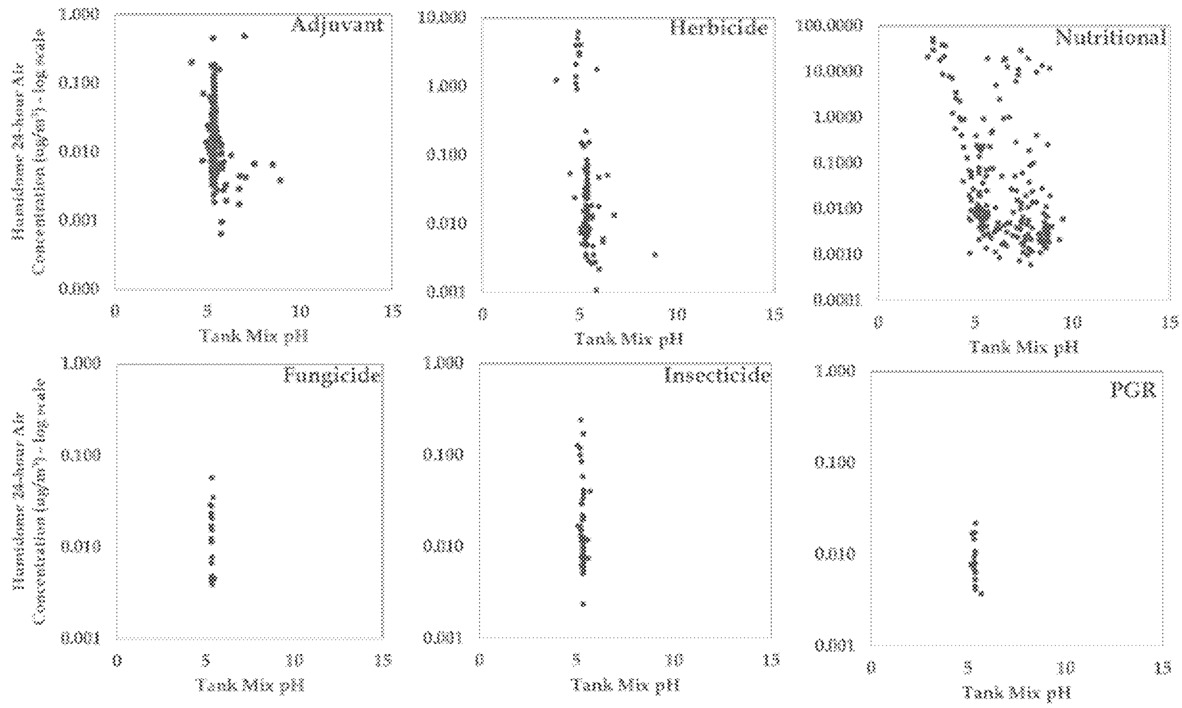

Figure 15. Tank mix pH and dicamba 24-hour air concentration as measured in humidome is not correlated by any one tank mix partner class[10].

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[10] These tank mixtures were comprised of XtendiMax and prospective tank mix partners that were evaluated for potential inclusion as approved tank mix partners for XtendiMax. Not all of these tank mixtures are enabled on the XtendiMax tank mix website.

pH of Source Water Used for Mixing XtendiMax in the Field Varies Between 6.1 and 8

Groundwater pH data was retrieved for the 34 states from 106,136 stations with a total sample count of 298,739. Based on this extensive dataset, average pH across the states ranged from 6.1 to 7.8 (Figure 16). Non-groundwater pH data, which includes surface water sources, was retrieved for the 34 states from 53,678 stations with total sample count of 1,744,817. Based on this extensive dataset, average pH across the states ranged from 6.5 to 8.2 (Figure 17).

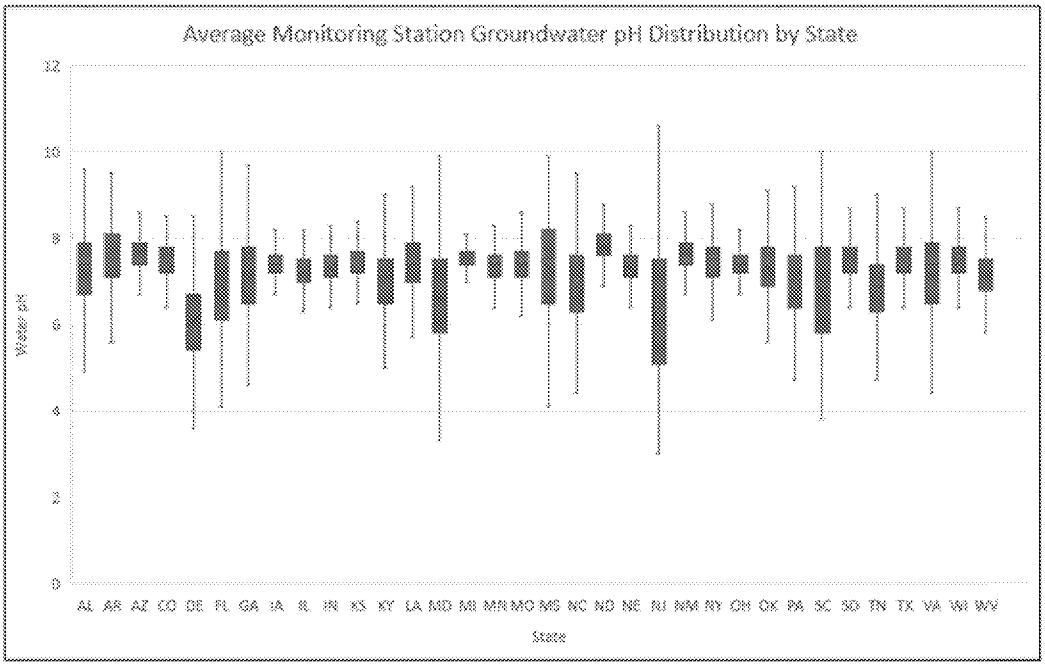

Figure 16. Groundwater pH ranges from 6.1 to 7.8 across 34 states based on an extensive dataset

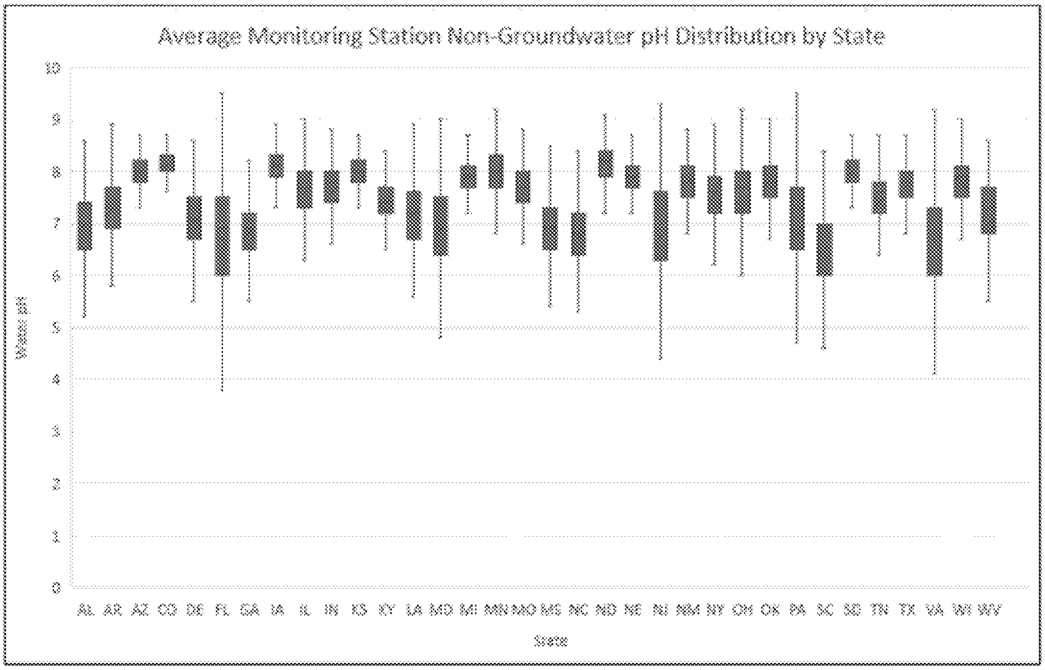

Figure 17. Non-groundwater, which includes surface water sources, pH ranges from 6.5 to 8.2 across 34 states based on

an extensive dataset

From the large database of humidome test results compiled by Monsanto using XtendiMax with various tank mix partners, there is no correlation between pH and dicamba air concentrations measured in the humidome *en masse* or by tank mixture class. Based on an extensive dataset, comprising of 34 states and thousands of samples, average groundwater pH ranged from 6.1 to 7.8 and average non-groundwater (i.e. including surface water) pH ranged from 6.5 to 8.2. These results, along with the results of the humidome study discussed above, demonstrate that low pH, either of the source water or resultant spray solution, does not increase the volatility potential of XtendiMax.

2018 USDA Yield Data Shows No Impact on Soybean Yield from Off-Target Movement Inquiries of Dicamba

Soybean yield data published for 2018 by the U.S. Department of Agriculture confirms data from 2016 and 2017 showing that there are no widespread yield impacts due to the off-target movement of dicamba. Even in Illinois (183 inquiries), Iowa (108 inquiries) and Indiana (56 inquiries) yield increased in 2018 relative to 2016 and 2017 or remained steady.[11] This is particularly notable given that 2016 and 2017 were themselves strong or record years for soybean yields in these states. Illinois, for example, accounted for approximately 26% of all the nationwide inquiries related to alleged dicamba off-target movement in the 2018 growing season, but also experienced the highest soybean yields per acre in the state's history that year.[12]

Even more telling are the yields per acre reported from the two specific counties in Illinois where growers reported the greatest number of off-target movement inquiries but where 2018 soybean yields increased from 2017 levels.[13] Logan County—which accounted for 42 inquiries related to alleged dicamba off-target movement—saw an 11% increase in soybean yields per acre from 2017 levels. Morgan County (with 14 inquiries) reported a marked 35.5% increase in yield per acre.[14] These data show that there is no negative correlation between inquiries reported and purported or actual decreases

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[11] *See* 2018 OTM Inquiry Data, reflecting a total of 710 inquiries received by Monsanto from across the United States in 2018.

[12] National Agricultural Statistics Service, https://quickstats.nass.usda.gov/ (last visited January 14, 2020) (select Program: Survey; Sector: Crops; Group: Field Crops; Commodity: Soybeans; Category: Yield; Data Item: Yield Measured in Bu/Acre; Domain: Total; Geographic Level: State; State: Illinois; Select Time: 2011 to 2018; Period Type: Annual) (showing soybean yields increasing to 63.5 bu/acre in 2018).

[13] *See* 2018 OTM Inquiry Data (Illinois; Logan County; Morgan County).

[14] *Compare* OTM Inquiry Data (Illinois; Logan County; Morgan County) *against* data available for yields in Illinois counties from USDA, National Agricultural Statistics Service, https://quickstats.nass.usda.gov/ (last visited January 14, 2020) (select Program: Survey; Sector: Crops; Group: Field Crops; Commodity: Soybeans; Category: Yield; Data Item: Yield Measured in Bu/Acre; Domain: Total;

in yield per acre.[15]

2018 also was a strong year for soybean yield in Iowa (56 bu/acre), and consistent with yields in 2017 (57 bu/acre), 2016 (60 bu/acre) and 2015 (56.5 bu/acre). Indiana also makes for a helpful comparison. USDA yield data confirms that Indiana tied its previous 2016 record yield per acre for soybean in 2018 (57.5 bu/acre).[16] The Indiana county with the greatest number of inquiries (White County) experienced a 4.3% increase in soybean yields per acre from 2017 levels.[17]

It was not just Illinois, Iowa and Indiana that experienced successes in soybean yields in 2018 despite dicamba off-target movement inquiries: growers in Arkansas, Mississippi, New York, and Ohio all set new state records for soybean on a yield per acre basis that year.[18] As another example, Monsanto received 34 off-target movement inquiries from Cass County, North Dakota in 2018 while experiencing an increase in yield of 16.2% per acre.[19]

Geographic Level: County; State: Illinois; Counties: Logan, Morgan; Select Time: 2017 and 2018; Period Type: Annual) (showing soybean yields grew between 2017 and 2018 for Logan and Morgan counties).

[15] For example, Logan County yields increased from 64.7 bu/acre (2017) to 71.8 bu/acre (2018); and Morgan County increased from 60.2 bu/acre (2017) to 81.6 bu/acre (2018). *See* USDA, National Agricultural Statistics Service, https://quickstats.nass.usda.gov/ (last visited January 14, 2020) (select Program: Survey; Sector: Crops; Group: Field Crops; Commodity: Soybeans; Category: Yield; Data Item: Yield Measured in Bu/Acre; Domain: Total; Geographic Level: County; State: Illinois; Counties: Logan, Morgan; Select Time: 2017 and 2018; Period Type: Annual).

[16] *See* USDA, National Agricultural Statistics Service, https://quickstats.nass.usda.gov/ (last visited January 14, 2020) (select Program: Survey; Sector: Crops; Group: Field Crops; Commodity: Soybeans; Category: Yield; Data Item: Yield Measured in Bu/Acre; Domain: Total; Geographic Location: State; State: Indiana; Time: 2019 through 1924; Period Type: Annual) (showing Indiana's soybean yield in 2018 (57.5 bu/acre) as tied with 2016, and an increase from the 2017 yield (54.0 bu/acre)).

[17] *Compare* OTM Inquiry Data (Indiana; White County) *against* data available for yields in Indiana counties from USDA, National Agricultural Statistics Service, https://quickstats.nass.usda.gov/ (last visited January 14, 2020) (select Program: Survey; Sector: Crops; Group: Field Crops; Commodity: Soybeans; Category: Yield; Data Item: Yield Measured in Bu/Acre; Domain: Total; Geographic Level: County; State: Indiana; County: White; Select Time: 2017 and 2018; Period Type: Annual) (showing soybean yields grew for White County from 58.8 bu/acre in 2017 to 61.3 bu/acre in 2018).

[18] 2018 Crop Production Summary at 123.

[19] *Compare* OTM Inquiry Data (North Dakota; Cass County) *against* data available for yields in North Dakota counties from USDA, National Agricultural Statistics Service, https://quickstats.nass.usda.gov/ (last visited January 14, 2020) (select Program: Survey; Sector: Crops; Group: Field Crops; Commodity: Soybeans; Category: Yield; Data Item: Yield Measured in Bu/Acre; Domain: Total; Geographic Level: County; State: North Dakota; County: Cass; Select Time: 2017 and 2018; Period Type: Annual) (showing soybean yields grew for Cass County from 37.6 bu/acre in 2017 to 43.7 bu/acre in 2018).

The appropriate conclusions from this data are plain: Inquiries related to dicamba off-target movement cannot be associated with any widespread yield losses on soybeans. In fact, the available data suggests that the most profound yield gains or maintenance of recent yield gains occurred in several of the locations where the highest numbers of inquiries originated.

The USDA recently released final yield data for the 2019 growing season. This data showed a nationwide decline in soybean yield due to challenging weather conditions across the majority of soybean-growing regions. Declines in soybean yield were observed in most states, even those with few or no off-target movement inquiries (e.g., North Dakota, South Dakota and New York), which suggests that these declines were caused by poor weather conditions and not by off-target movement.

Off-Target Movement Inquiries Declined in 2019 While Xtend Acreage Increased

Prior to the 2019 growing season (January – April), Monsanto continued its efforts to train and educate growers regarding label requirements, which reinforced grower compliance during the growing season and further reduced inquiries related to potential off-target movement. Building on its success in reducing off-target movement inquiries during the 2018 growing season, Monsanto agreed to additional label restrictions for the 2019 and 2020 growing seasons, including:

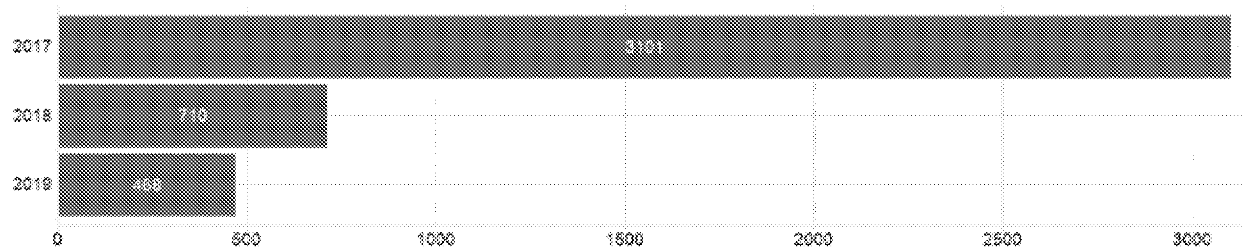
- XtendiMax is limited to a maximum of two over-the-top applications on both soybean, and cotton and the spray application window is restricted by growth stage and days after planting;
- XtendiMax may not be applied between two hours prior to sunset and one hour after sunrise;
- XtendiMax may be applied by certified applicators only (Restricted Use Pesticide); and
- XtendiMax applications require a 57 ft omnidirectional buffer in counties where endangered species are present.

As part of the 2018 XtendiMax conditions of registration, EPA required Monsanto to report to EPA on a monthly basis key information relating to off-target movement inquiries made to Monsanto. Such information includes the acreage involved, plant species involved, severity of alleged damage and any determination that dicamba symptomology resulted from product misuse. Previously, there was no consistently collected, investigated and reported data regarding dicamba off-target movement that included all of these data points. Monsanto's efforts in the 2019 growing season to evaluate telephone calls regarding alleged off-target movement demonstrated a range of specific circumstances, including neighboring dicamba applications over corn in many locations; issues with crops impacted by other non-dicamba herbicides; crops impacted by other phenomena such as disease or weather; applications that did not comply with required label conditions; and circumstances where the crops at issue were not actually impacted, much less impacted by any herbicide application.

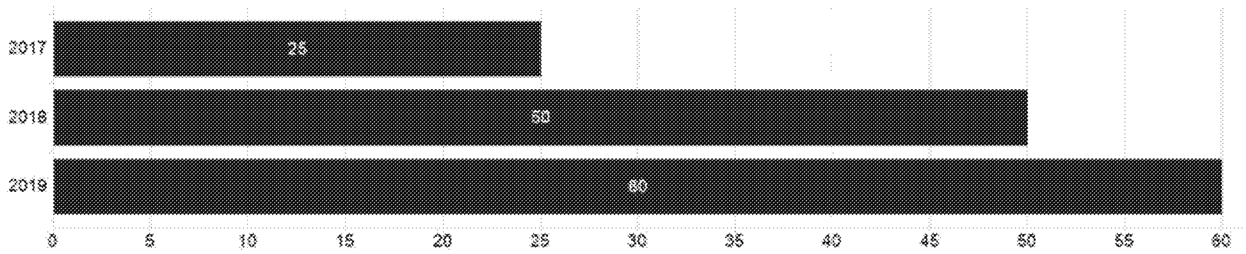
As has become evident through our evaluations in 2019 and in prior growing seasons, the number of inquiries received does not necessarily correspond with any actual "injured" acreage associated with dicamba. Indeed, as we have in the past, we urge extreme caution in assuming any level of acreage injured simply based on the number of inquiries identified. Without specific evaluations, any assumptions of what actually occurred on the field are not possible, and it is certainly not possible to equate the number of calls received with any allegedly harmed acreage totals from on-label applications of XtendiMax, Engenia, and/or FeXapan. Any such assumptions would be unscientific.

Monsanto has conducted a detailed and robust evaluation of each inquiry it received during the 2019 growing season. As shown in the following graphs (Figure 18), the number of inquiries received by Monsanto regarding possible off-target movement decreased in 2019 compared to 2018 and 2017. During this same time, Xtend soybean and cotton acreage continued to increase.

OFF-TARGET MOVEMENT INQUIRIES



ROUNDUP READY XTEND CROP SYSTEM ACRES IN MILLIONS



INQUIRIES PER MILLION ACRES PLANTED

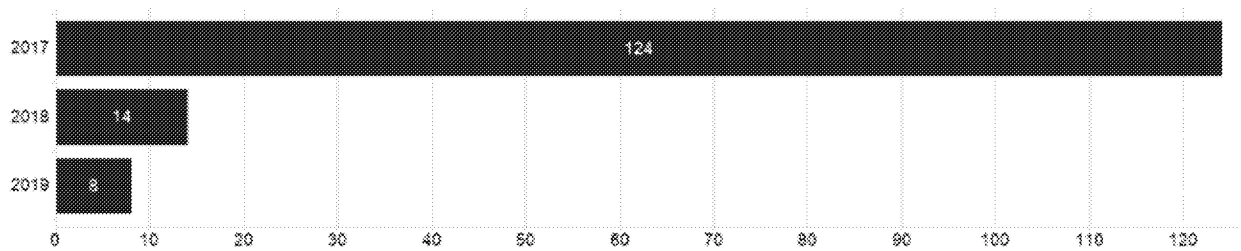


Figure 18. Off-Target Movement Inquiries Reported in 2017 – 2019

In 2019, Monsanto received a total of 468 individual inquiries regarding off-target movement potentially related to dicamba. Of those, 161 were reported by applicators and 307 were reported by non-applicators. A review of all 468 of those inquiries has been completed. The vast majority of non-applicator inquires received by Monsanto in 2019 (271 of 307) were regarding potential symptomology on non-dicamba tolerant soybeans.

Monsanto received fewer off-target movement inquiries in 2019 relative to 2018 for most individual states where XtendiMax is registered, including Illinois, Indiana, Minnesota, Tennessee and Missouri. Many states for which Monsanto received inquiries in 2018, including North Dakota, South Dakota, Wisconsin, Texas, Georgia, South Carolina, Virginia, Maryland, Kentucky and New York had zero inquiries in 2019. Colorado, New Mexico, Alabama, Florida, West Virginia, Delaware and New Jersey had no inquiries in 2018 or 2019. Monsanto received more inquiries for 2019 relative to 2018 only in Pennsylvania, Iowa, Arizona and Mississippi, however in all cases the increases were minor. Monsanto did not commercialize XtendiMax in Arkansas in 2018, and in 2019 received 13 inquiries in the state. In total, the overall decrease in inquiries reported to Monsanto for all states was 34% from 2018 to 2019.

As shown above in Table 5, 307 non-applicators made off-target movement inquiries to Monsanto in 2019, which is a decrease from 450 inquiries in 2018. Of those 307 inquiries, six growers refused visits from a Monsanto Field Engagement Specialist (FES) and thus were not investigated. In addition, 29 inquiries were made by plaintiffs in ongoing product liability litigation relating to dicamba, and thus are excluded from the inquiry analysis in this submission. 161 applicators made off-target movement inquiries in 2019, which is a decrease from 260 in 2018. Monsanto continues to implement a robust and rapid process for evaluating inquiries into off-target movement, whether reported by herbicide applicators or by non-applicators.

Monsanto has implemented a fulsome process to provide EPA with the information required in the 2018 XtendiMax conditions of registration. FESs objectively evaluate every inquiry reported to Monsanto. Every off-target movement inquiry call is answered within two business days, and every field or site is visited as soon as possible, with the goal being three business days after a return call from the party making the inquiry is obtained. For incidents reported by non-applicators, the FES assesses the inquiry field to identify symptomology and impacted crops. All relevant facts are documented, including a precise measure of potentially impacted fields; expert panels, independent from the FESs, review and evaluate all facts collected throughout this process. The data collected through this process is entered and mapped in a database that includes a summary of conclusions obtained from each field inquiry.[20]

Table 5. Total Inquiries Evaluated as Required by the 2018 XtendiMax Conditions of Registration (By State) in 2018 and 2019

[20] Each individual inquiry may have information to support more than one conclusion, resulting in a total exceeding the number of non-applicator inquiries.

Field State	2018 OTM Applicator	2018 OTM Non Applicator	2019 OTM Applicator	2019 OTM Non Applicator
AR	-	-	-	13
AZ	-	-	1	1
GA	1	5	-	-
IA	63	45	77	40
IL	67	116	18	133
IN	23	33	25	14
KS	9	36	10	31
KY	1	17	-	-
LA	1	8	-	1
MD	1	3	-	-
MI	15	6	2	1
MN	9	13	1	4
MO	28	25	5	43
MS	-	-	-	4
NC	-	4	-	2
ND	3	40	-	-
NE	11	21	13	11
NY	3	-	-	-
OH	10	18	6	3
OK	-	9	-	2
PA	4	1	3	3
SC	1	1	-	-
SD	8	17	-	-
TN	-	27	-	1
TX	-	3	-	-
VA	-	2	-	-
WI	2	-	-	-
Total	**260**	**450**	**161**	**307**
Total (OTM + Non OTM)		**710**		**468**

It is important to evaluate each field of each inquiry to understand the nature of any potential symptomology and to identify potential source fields. Typically, only a portion of a field shows symptomology, and this symptomology diminishes rapidly as distance from the source field increases. As such, entire fields typically do not demonstrate symptomology. As required by the 2018 XtendiMax conditions of registration, Monsanto evaluated the severity of observed symptomology on each field. In 2019, a total of 268 non-applicator off-target movement inquiries resulted in a total of 23,836 acres mapped by an FES. Of these acres, 6,832 acres did not exhibit any dicamba symptomology. The remaining 17,004 acres exhibited probable dicamba symptomology. As shown below in Figure 19, approximately 75% (12,869 acres) of the acres with probable dicamba symptomology were determined have symptomology that was "slight" in nature, and 24% (3,993 acres) and 1% (142 acres) had probable symptomology that was moderate and severe, respectively.

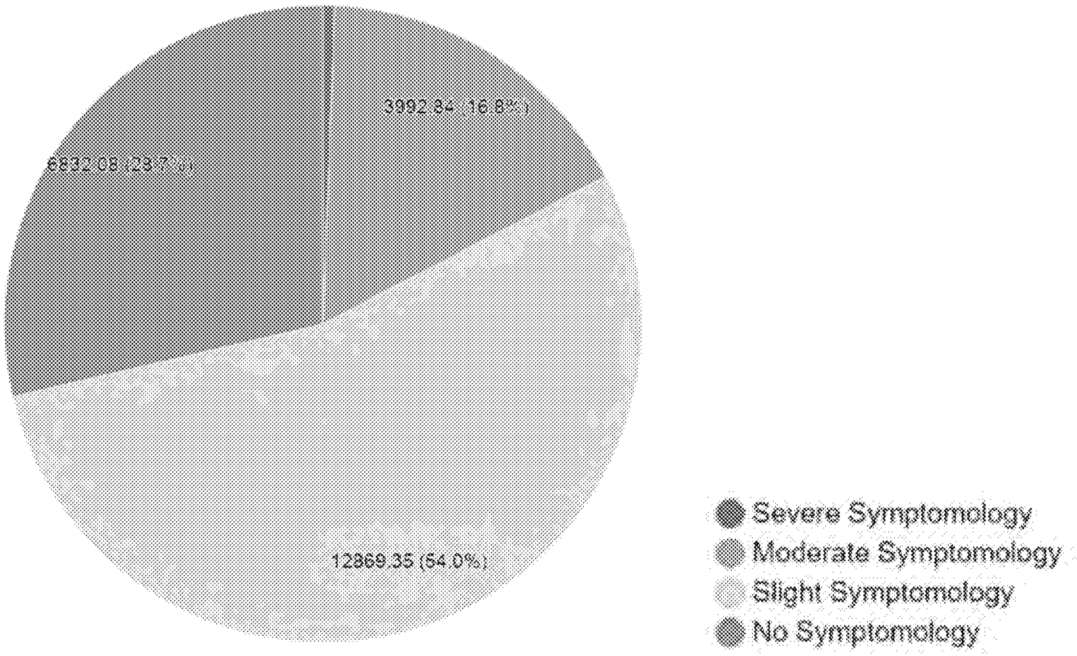


Figure 19. Severity of Probable Symptomology on Acres Investigated by Monsanto

The reduction in applicator off-target movement inquiries reported to Monsanto demonstrates the effectiveness of applicator training. As shown in Figure 20 below, incidents of applicator-reported failures to follow specific application requirements decreased from 2018 to 2019.

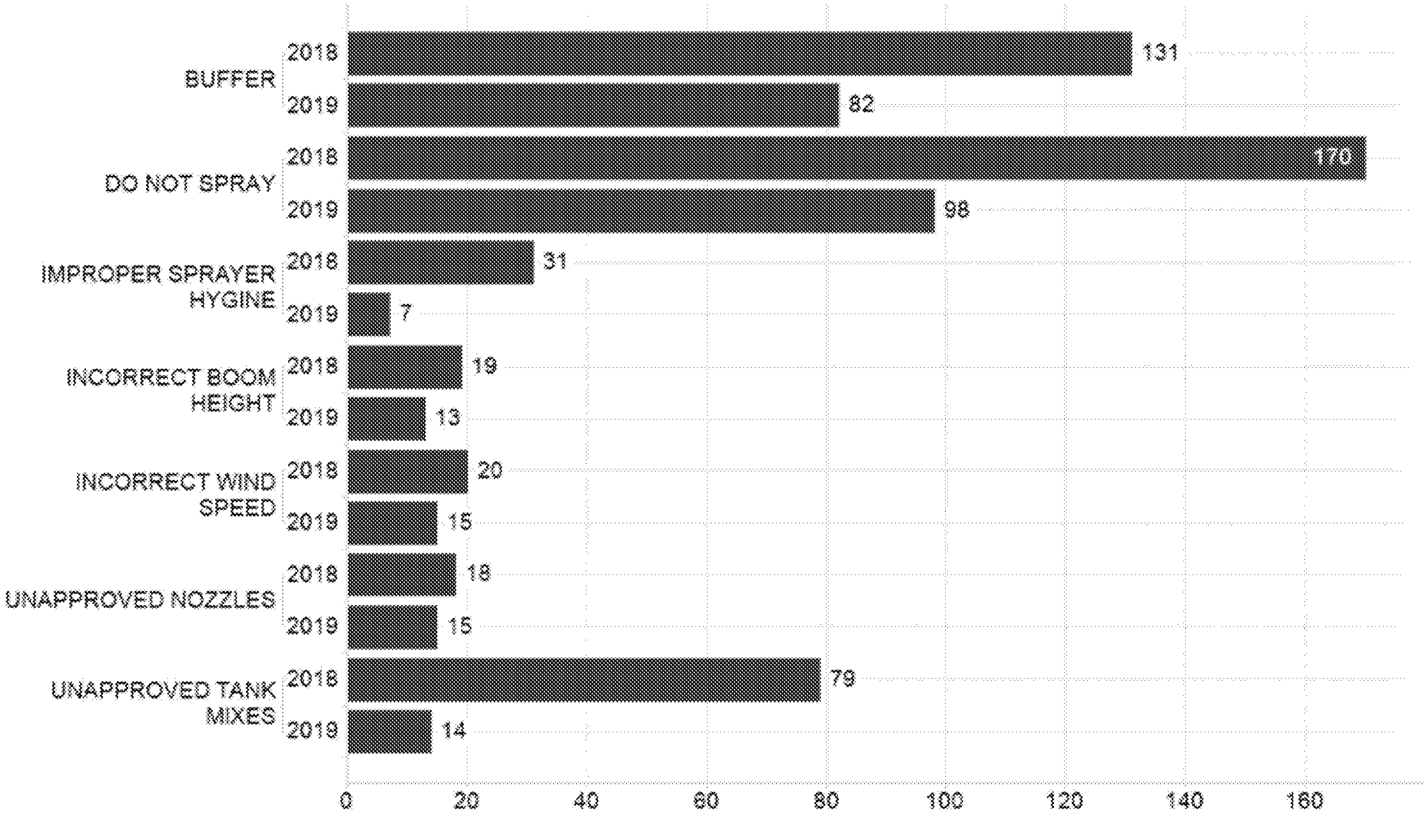


Figure 20. Incidents of applicator-reported failures to follow specific application requirements decreased from 2018 to 2019.

Other dicamba formulations remain widely available and widely used on corn, small grains and pastureland and continue to increase year-over-year. The increased usage of dicamba products is primarily due to the effectiveness of dicamba in controlling resistant broadleaf weeds (i.e., PPO, glyphosate, etc.).

Additionally, dicamba products not registered for use in dicamba-tolerant soybean and cotton continue to increase. These dicamba formulations account for a significant portion of dicamba applications and, importantly, these dicamba formulations lack significant formulation advances that are designed to minimize off-target movement. Although these formulations have certain label restrictions, for dicamba formulations that are not labelled for use in dicamba-tolerant soybean and cotton, the following are typically true:

- Are not restricted use pesticides and can be applied by anyone;
- Have no requirements for training to teach applicators how to minimize off-target movement before they can use the product;
- Can be mixed with any product—including AMS—that may further increase drift and volatility potential;
- Need not be used with a drift reduction agent;
- Can be applied without any buffer to minimize downwind off-target movement;

- Can be applied using many nozzle-types rather than being restricted only to ultra-coarse nozzle types that minimize drift potential;
- Can be applied between sunset and sunrise, when temperature inversions that exacerbate off-site movement are more likely to occur;
- Can be applied aerially during high wind events; and
- Are not subject to reporting and recordkeeping requirements.

Because dicamba formulations not registered for use in dicamba-tolerant soybean and cotton are less expensive than XtendiMax, many corn and small grain growers may prefer to use these lower cost dicamba products rather than XtendiMax. Because sales of lower-cost dicamba formulations have increased significantly in recent years, applications of these dicamba formulations may be responsible for a portion of the reported inquiries into off-target movement. In 2019, particularly in Illinois, for many of the inquiries that we investigated involving non-applicator reported acres, adjacent corn fields surrounded non-dicamba tolerant soybean fields. Given late planting this season (mainly due to extreme weather conditions), those corn fields may have received an application of dicamba or another auxin at the same time as over-the-top dicamba soybean applications. In approximately 10% of 2019 non-applicator inquiries (27 out of 272), the field exhibiting symptomology was entirely surrounded by crops other than soybeans or cotton (i.e., corn, small grains, pasture). In addition, 86% of fields exhibiting uniform symptomology had at least one corn field within 150 feet of the inquiry field, and 75% of inquiry fields had two or more corn fields within 150 feet of the inquiry field.

143 inquiry fields that exhibited suspected dicamba symptomology were adjacent to a field that may contain non-Xtend crops where dicamba may have been used. More specifically, 96 of 116 fields exhibiting uniform symptomology (not due to spray system hygiene) were suspected to be caused by exposure from multiple adjacent dicamba-tolerant crops. These crops included corn, Xtend soy or cotton, small grains, pasture, or prevent plant. Of those 96 fields, 83 had one or more corn fields immediately adjacent to the inquiry field.

Finally, 29 inquiry fields exhibited symptomology that was likely caused by applications made to an adjacent field containing an auxin-labeled crop besides Xtend soybean or cotton, 42 inquiry fields exhibited symptomology from an herbicide other than dicamba, and 44 exhibited agronomic symptomology unrelated to herbicide exposure (e.g., disease, fertility, environment, etc.). Using data collected by FESs, expert panels concluded that suspected tank or spray system contamination was the cause of dicamba symptomology on an additional 29 fields.